

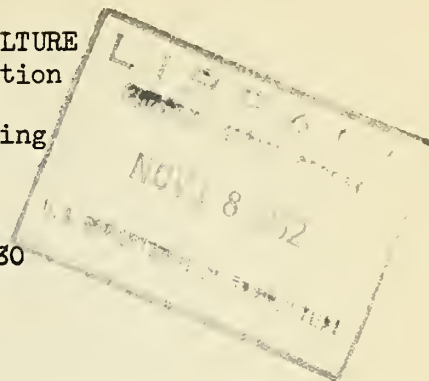
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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Plant Industry
Soils, and Agricultural Engineering

H. T. & S. Office Report No. 280



✓ RAIL REFRIGERATION TESTS WITH FLORIDA CITRUS
MAY 1951 X =

✓ By

J. R. Winston, Senior Horticulturist
Randall Cubbedge, Scientific Aid
H. W. Hruschka, Associate Physiologist
G. A. Meckstroth, Associate Pathologist

Division of Handling, Transportation and
Storage of Horticultural Crops

September 1952
Orlando, Florida

RAIL REFRIGERATION TESTS WITH FLORIDA CITRUS
MAY 1951

INTRODUCTION

This report, the third in a series of three^{1/} on the subject transportation tests with Florida citrus fruits conducted during the shipping season of 1950-51, gives an accounting of an accompanied transportation test made in mid-May, 1951.

The background, objectives, and overall plan followed in this investigation do not need repeating, since they were given in detail in the report on the test conducted in November, the first of this series. The May test, the subject of this report, was planned to take place during the warm weather of late spring when refrigeration is being used by all shippers, the specific service varying more with the beliefs of the several shippers than with actual needs. Since each of these transportation tests differed from the other in detail of planning and execution in order to cope with seasonal differences in weather and commodity, the complete plan of the test in tabular form, table 1, is presented to afford means of a quick appraisal. The loading methods and car types as well as the contrasting protective services used are shown in the table. The test consisted of 12 cars of oranges and grapefruit that may be grouped as follows: 1) three carlots precooled in rooms prior to loading; 2) three carlots precooled after loading; and 3) six carlots non-precooled.

This test was conducted during a period of fair, warm weather with outside air temperatures a few degrees below normal on the day of loading reaching 10 degrees below normal as the train moved through North Carolina. Normal temperatures were reached the third day after loading, and they remained nearly normal thereafter.

It was necessary to load the several cars under test at widely separated shipping points, viz., in Indian River and St. Lucie Counties on the East Coast of Florida, and in Lake and Polk Counties in the central district, with fruit grown under varying conditions. Therefore, in order to have comparable fruit for purposes of critical inspection at destination, a crate of oranges of a variety being shipped in quantity at that time of identical origin and packing-house treatment, was placed in the same

^{1/} The first of these three tests was conducted during a cold spell in late November, 1950; the second in early April, 1951; and were reported in HT&S Office Reports No. 277 and No. 279, respectively.

location (top, at or near the quarterlength position) in each car. The test lot selected for comparative evaluation at destination was U. S. No. 2 (Natural Color) Indian River Valencia oranges, size 200, picked, packed and loaded at intervals of 1 day between each of these steps. Although the first inspection was made as soon as possible after each car was unloaded, there was an interval of from 6 to 7 days between picking and inspection at destination. The second and final inspection was made 1 week after the first.

The test cars were loaded May 17. That night they moved toward Jacksonville where they were consolidated into one through train which left Jacksonville May 18 during the late afternoon and arrived at Savannah at 10:00 p.m. The test cars were at Florence by 4:30 the second morning; at Rocky Mount by 12:45 p.m.; at Richmond by 4:45 p.m.; and at Potomac Yards by 10:15 p.m. The test cars were separated at this point and went forward in different trains unaccompanied by the observers. Probably all of them were at or near their destination within 24 hours after arrival at Potomac Yards and five were unloaded during the fourth night after loading. The remaining seven cars were unloaded either the following day or during the fifth night.

All of the cars that were re-iced only once received this service at Florence while those given standard refrigeration were re-iced at New Smyrna, Florence, and Potomac Yards. Cars F and L, of the latter group, were re-iced after arrival at destination while waiting to be unloaded. The vents were kept closed in all cars from the hour of initial icing until they were unloaded.

RESULTS

Because of the volume of data, no attempt will be made to discuss it in great detail but only to summarize the essential points. For anyone desiring a more detailed study, the complete temperature and icing records are contained in the tables and figures included in this report. Table 1 lists all of the test cars, size and method of loading, type of car, and protective service used. Average fruit temperatures in transit are contained in tables 2 and 3, with ice consumption data in tables 4 and 5. A summary of rind breakdown and decay is presented in table 6. Transit and precooling temperatures are given in tables 7 to 21 and graphically shown with certain comparisons in figures 1 to 10.

Summarized Comparison of Temperatures

Room-precooled fruit. Three methods of shipping room-precooled fruit were compared. One shipment was made in a fan car (car A), another in a non-fan car (car B), both with full bunker icing, and a third in a non-fan car with half-stage icing (car C). All were pre-iced cars loaded with standard crates, shipped under item 80, section 2, re-iced at Florence, S. C., with vents closed to destination. The top, middle, and bottom layers of car A were close to 40° F. for most of the transit period, whereas the top layer

of non-fan car B was held at 50°, the bottom layer at 40°, and the middle layer at about 45° (Fig. 1 A and B). The car receiving stage icing, car C, (Fig. 2 A) had temperatures almost identical with those of full bunker-iced car B, both non-fan cars. This comparison indicated that stage icing service, costing about 78 percent of full bunker icing provided as good temperatures as the more costly service. Fan cars again provided more uniform temperatures than non-fan cars even when the cars were loaded with fruit precooled to temperatures in the range of 41° to 50°.

Car-precooled fruit. A comparison was made between fan cars loaded with warm fruit, packed in standard crates, one of which was not precooled, car D, and the other, car E, precooled for about 5-1/2 hours with the built-in fans. These cars were pre-iced and shipped under item 80, section 2, re-iced at Florence, S. C., vents closed to destination. The precooling record of car D is shown in Fig. 3, and as indicated, the top layer was cooled to 56° F. from an initial temperature of 68°, and the middle and bottom layers to 60° and 58°, respectively. The total cooling averaged about 12 degrees for the load. This car had little better temperatures in transit than the non-precooled comparison car E - both reaching an average of about 56° at Florence, S. C., cooling rapidly after the re-icing received there to a final temperature of about 45° on arrival (Fig. 2 B and 4 A). In other words, short precooling of 5 or 6 hours with air of 50° and above was of little advantage over shipment in a fan car not precooled.

Another method of precooling was tried in a double-deck, non-fan car loaded with 5-pound mesh bags of oranges (car F). It was precooled for about 6-1/2 hours with a truck-mounted precooling unit, the top layer being cooled from about 80° F. starting temperature to 50°, the bottom layer to about 67°, and the middle layer to about 63° (Fig. 5). The average temperature reduction for the load amounted to about 19 degrees. The comparison car (car G) was a fan-car precooled with the built-in fans for about 6 hours, the top layer being cooled to 52° from an initial temperature of 73°, and the middle and bottom layers were cooled to only 62° (Fig. 6). The average temperature reduction was 16 degrees for this car. The transit temperatures of these two double-deck cars, both precooled, one a non-fan car and the other a fan car, are shown in Figure 4 B (car F, non-fan) and 7 A (car G, fan car). These cars were re-iced once in transit, at Florence, S. C., and the fan car was pre-iced for precooling, the other car was not initially iced until after loading. The top layers of the non-fan car F rose rapidly from 50° F. at the end of precooling to about 65° in 12 hours, and was 60° or above most of the time in transit (Fig. 4 B). In contrast, the top layer of the fan car rose only a few degrees after precooling and held at about 54° until the car was re-iced at Florence. Then it dropped in about 10 hours to 43°, rising gradually to 50° upon arrival (Fig. 7 A). This car had more uniform and cooler temperatures than the non-fan car. The fast cooling of the fan car after re-icing at Florence indicated this desirable drop in temperature would have been accomplished a day earlier if the car had been re-iced the morning following cooling, say at Sanford. This car had 3,600 pounds of ice remaining in its bunkers on arrival and a day's earlier re-icing would have permitted using more of this ice to cool the fruit.

Non-precooled fruit. A number of methods of shipping non-precooled fruit were compared in this test. Cars H and I consisted of a pair of cars, one a fan car and the other a non-fan car, loaded with warm fruit packed in standard crates and shipped in pre-iced cars, item 80, section 2, re-iced at Florence, S. C., vents closed to destination. The transit temperature record of fan car H shows a gradual reduction in temperature from loading at 75° F. in top and middle layer to 48° to 50° in 2 days, and then a leveling off to temperatures of 45° to 50° at destination (Fig. 7 B). In the non-fan car I, the top and middle layers cooled from a 75° loading temperature to 58° to 60° in 2 days, a 10 degree differential in favor of the fan car (Fig. 8 A). The bottom layer was well refrigerated, reaching 50° in 1-1/2 days and 40° two days later on arrival. It was 20 degrees colder than the top layer upon arrival. The differences in these cars can be stated simply. The fan car brought the entire load to 50° and lower temperatures in about 2 days; the non-fan car refrigerated only the bottom layer effectively, allowing the top layer to stay in the range of 60° to 70° most of the trip, and the middle layer at 53° to 70°. The question can be asked, would the non-fan car have performed better under standard refrigeration service? Car J was handled in this manner. These two cars, I and J, were compared in Fig. 8 A and B. Cooling rates were slightly faster in the car iced more frequently, and total cooling was slightly greater, with the net result that upon arrival the top layer was about 5 degrees cooler, the middle layer 12 degrees cooler, and the bottom layer 4 degrees cooler in the car receiving standard refrigeration than in the comparison car. The large spread in temperature between top and bottom layers still prevailed, and top layers were not well refrigerated, in spite of frequent icing.

Would half-stage icing do as well as standard refrigeration if more refrigeration were needed than is supplied by initial icing and one re-icing in transit? Two cars of non-precooled fruit were refrigerated in this manner, one a fan car and the other a non-fan car, cars K and L, respectively. They are compared in Fig. 9 and the usual advantages of more uniform temperatures, faster cooling, and lower temperatures in top and middle layers in transit are apparent. When the non-fan cars, half-stage and full bunker icing are compared (cars L and J, Figs. 9 B and 8 B, respectively), the half-stage icing appeared to reduce the spread between top and bottom layers to about 10 degrees as compared with a 20 degree spread in the full bunker iced car. The top layers were refrigerated about the same in the two cars and the middle and bottom layers more in the full bunker car than in the half-stage car. Considering the entire load, the half-stage fan car made a better showing than the non-fan car with full bunker, both moving under standard refrigeration services (car K, Fig. 9 A - versus car J, Fig. 8 B).

Further comparison of icing services and non-fan and fan cars. The average maximum and minimum temperatures of three cars shipped under standard refrigeration, cars J, K, and L, and three shipped under item 80, section 2, are compared in Fig. 10 A. These records show no advantage for the more

costly standard refrigeration service. Minimum temperatures were slightly lower in these cars, but maximum temperatures were slightly higher in the cars initially iced and re-iced only once in transit.

The average maximum and minimum temperatures in three non-fan cars, I, J, and L, and three fan cars, E, H, and K, shown in Fig. 10 B, bring out the fact that the fan car is good protection against high maximum temperatures. The cooling obtained by forcing air over the top of the load is responsible for this. Conversely, the lower minimum temperature in the non-fan cars is the result of slow movement of cold air to the bottom of the load, producing much cooling here but little in the warm top layers.

Icing Record of Test Cars

Room-precooled fruit. Two of the three cars (A and B) loaded with room-precooled fruit were given full bunker icing, item 80, section 2; the other (C), was given stage icing. All were re-iced once en route. The former were supplied with 13,600 and 13,200 pounds of ice, respectively, to destination, while the latter received 7,600 pounds of ice during the same period, table 4. Ice meltage during that period was 7,700 and 6,000 pounds, respectively, in cars A and B, and 5,200 pounds in car C, while the amount of ice remaining in the bunker at unloading was 5,800 pounds in car A, 6,700 pounds in car B, and 2,000 pounds in car C.

Fruit precooled after loading. Three of the nine cars loaded with warm fruit were precooled after loading. Car F was precooled with a truck-mounted mechanical unit while the other two cars, G and D, were precooled with ice and Preco car fans. Each of these cars was re-iced only once. Total ice supplied ranged from 13,200 pounds for car F, to 19,000 pounds each for cars G and D, table 4. Ice meltage up to the hour of unloading which took place 44 hours after re-icing car D and 53 hours after re-icing cars F and G, was 11,100 pounds in car F, 15,200 pounds in car G, and 14,600 pounds in car D. At unloading the amount of ice remaining in these cars was 2,100, 3,800, and 4,400 pounds in cars F, G, and D, respectively.

Non-precooled fruit. Cars J, K, and L, given standard refrigeration received a total ice supply during the transit to destination of 21,700, 16,400, and 14,000 pounds, respectively, or an average of 17,367 pounds, tables 4 and 5. Cars E, H, and I, re-iced only once received 18,600, 19,600, and 16,200 pounds, respectively, or an average of 18,133 pounds, tables 4 and 5. Thus the cars re-iced but once received approximately 750 pounds more ice per car than was given the cars under either half-stage or full bunker standard refrigeration.

Ice meltage up to the time of arrival at destination, ranged from 12,800 pounds to 15,500 pounds in the cars under standard refrigeration, and from 11,400 pounds to 16,300 pounds in the cars re-iced only once; an average of 14,100 pounds in the former cars and 13,833 pounds in the latter, or a difference of 267 pounds.

On arrival at destination ice remaining in the bunkers of the three cars (J, K, L) given standard refrigeration ranged from 2,400 pounds in a car receiving stage icing, to 6,200 pounds in the car given full tank service; and from 3,300 pounds to 4,800 pounds in those (cars E, H, I) given only one re-icing; an average of 3,267 pounds in the former cars and 4,300 pounds in the latter, a difference of approximately 1,000 pounds.

Ice Meltage in Relation to Change in

Commodity Temperature During Transit

Mechanically-precooled fruit. In the three cars, A, B, and C, loaded with room-precooled fruit, the ice melted (table 4) in keeping the cars cold and holding or reducing the average temperature of the load up to the time of arrival at Jersey City was 7,700, 6,000, and 5,200 pounds, respectively. In car A there was a rise of less than 1/2 degree in fruit loaded at 41.2° F. while in cars B and C with loading temperatures of 46.6° and 47.2° there was a reduction of 2.7 and 2.5 degrees, respectively (table 2). Since the change in commodity temperature during the transit period was negligible, the ice meltage was consumed largely in offsetting heat leakage through the car walls since the heat of respiration is not appreciable at these low temperatures.

In car F, precooled with a truck-mounted mechanical unit and without ice in its bunkers until 18 hours after loading, and re-iced only once during transit, there was an ice meltage of 11,100 pounds (table 4) accompanied by a reduction in commodity temperature of 11.1 degrees after the initial icing.

Cooled with ice. Eight cars, D, E, G, H, I, J, K, and L, loaded with warm fruit throughout, received all their refrigeration from ice meltage. This ice meltage ranged from 11,400 pounds in car I loaded with 74.9° F. fruit to 16,300 pounds in car H loaded with 74.7° fruit, both cars being given one re-icing. The temperature reduction was 22.0 degrees in the former car and 27.8 degrees in the latter.

Comparison of icing service. Ice meltage averaged 14,100 pounds in the three cars (J, K, L) given standard refrigeration, table 5, and 13,833 pounds in the three cars (E, H, I) re-iced only once. This meltage was accompanied by a commodity temperature reduction of 24.7 degrees in the former cars and 25.7 degrees in the latter.

Comparison of car type. Ice meltage in the three non-fan cars (I, J, L) during the transit period averaged 13,233 pounds; while in the three fan cars (E, H, K) it averaged 14,700 pounds. This meltage was accompanied by a commodity temperature reduction of 23.5 and 26.9 degrees, respectively, table 5.

Inspection of Oranges from Test Cars:

Rind Breakdown and Decay

Natural-color Valencia oranges somewhat beyond their prime condition were used as test fruit. Normally, the Valencia orange in mid-May is more susceptible to stem-end rot than is the case earlier in its season, and green mold rot is less prevalent than during the cooler months. The test fruit was not subjected to either the ethylene treatment to degreen the rind, or the "color-added" treatment to heighten the color. These color-changing treatments may accentuate rind breakdown.

The test fruit was picked 2 days before loading in the cars and an interval ranging from 4 to 5 days transpired between loading the cars and inspecting the test fruit soon after unloading. After the first inspection for rind breakdown and decay, the test packages were held for 1 week at room temperature and then the second and final inspection was made. The results are given in table 6.

Rind breakdown. No rind breakdown was found in any of the test crates regardless of protective service employed during the transit period at either the first or second inspection.

Decay. At the first inspection total decay, fairly equally divided between stem-end rot and green mold rot, ranged from 0 to 1.5 percent, an average of 0.6 percent, and was not consistently associated with either high or low temperatures, as evidenced by the 0.5 percent decay that developed during the transit period in car A and the absence of decay in car I, the lots with the lowest and highest average temperatures. After 1 week at room temperature, stem-end rot and green mold decay had increased appreciably and ranged from 2.0 to 7.5 percent, an average of 5.2 percent. The unusually high percentage of decay in the lot from car F suggests an error, hence it is not included in averages. The least amount of decay, 2.0 percent, was in the two room-precooled lots in cars A and B; the greatest amount of decay, 7.5 percent, was found in the non-precooled fruit in fan car E and non-fan car I. Again the green mold fungus caused about one-half of the decay, and again the decay-retarding benefits of deep precooling in rooms and low transit temperatures seemingly had been largely spent within a week after unloading.

DISCUSSION

Shippers generally are agreed that refrigeration in transit is desirable and at times necessary, especially in warm weather. There is a wide difference of opinion among them regarding the length of time that should lapse between loading a pre-iced car and re-icing it, and the need for more than one re-icing during a transit period of 4 to 5 days.

A moderate amount of Florida fruit is precooled in rooms prior to loading and there is an increasing amount precooled in the car immediately after loading, especially after loading in fan cars, yet the majority of shipments are not precooled.

In the case of room-precooled fruit the ice meltage during transit serves mainly to compensate for heat leakage through the car walls since the commodity is usually at a safe temperature before loading.

In the case of fruit that is loaded while warm the principal demand on ice meltage takes place during the first 2 days of the transit period since rarely is a car of citrus held at destination more than a few days before unloading.

Although there was a slight rise in commodity temperature in a few cars while standing at destination, it was mostly in the top of the load and was not of sufficient duration or magnitude to affect the well-being of the fruit.

Experience has shown that at the time of unloading from 3 to 5 days after loading, the bunkers are sometimes almost full of ice, and often they contain more ice than is necessary. This surplus of unmelted ice serves no useful purpose to the lading and is an economic waste to the shipper and the grower. While no great amount of ice need be maintained in the bunkers to hold fruit temperatures down after they are reduced to a safe level, the desirable amount varies with the outside air temperature as well as the temperature of the commodity, but it is likely to be less than shippers generally assume to be necessary.

Room-precooled fruit. Cars A, B, and C, the latter stage iced and all re-iced only once at Florence, South Carolina, arrived at destination, 4 days after loading, with an average pulp temperature of 41.5° F., 43.9°, and 44.7° respectively, with a change of +0.3, -2.7, and -2.5 degrees, respectively, during the transit period. Even more significant from the viewpoint of cost is the fact that the full tank fan car had 5,800 pounds of ice in the bunkers on arrival and the non-fan car had 6,700 pounds, enough to hold satisfactory temperatures for several days without further re-icing, while the stage-iced non-fan car had 2,000 pounds, enough to hold safe temperatures for at least another day. The refrigeration from the melting of ice in transit served more to maintain the initial loading temperature by absorbing heat passing through the car structure rather than to further cool the loads of the room-precooled fruit.

Fruit precooled after loading. In cars F, G, and D, the former car precooled with a mechanical unit mounted on a truck and the two latter precooled with ice and Preco fans, the pulp temperature of the fruit was reduced 18.8, 16.0, and 12.1 degrees, respectively, before the cars left their shipping points.

There was but little change in average commodity temperature between Sanford or New Smyrna and Florence in the fan cars or in the top of the load in the non-fan car. In the fan cars this was probably due to a dwindling supply of ice, which when replenished at Florence was followed by a prompt resumption in cooling activity; while in the non-fan car the cooling was noticeably slower especially on the top layer of these loads.

By the second morning there was no significant difference in temperatures between loads precooled after loading and the non-precooled loads.

At unloading there was 2,100 pounds of ice in car F, 3,800 and 4,400 in cars G and D, respectively, enough to hold their arrival temperature for 1 to 3 days.

Full bunkers vs. half-stage icing. There was no significant difference in temperature reduction in the top of the load - the danger zone, - between full bunker and half-stage icing standard refrigeration. Since the cost of the latter is approximately 78 percent of that of the former, the less expensive service seems worth considering. On arrival at destination the stage-iced cars had approximately 2,000 pounds of ice remaining, enough to hold safe temperatures a day or two in warm weather without re-icing. It should be remembered that cars moving under standard refrigeration must be delivered to the receiver with the bunkers at least three-fourths full of ice. Thus, in the case of cars with bunker ice capacity of 9,600 pounds, the one given full tank service must be delivered with at least 7,200 pounds of ice, whereas the stage-iced car must have 3,600 pounds. While this difference may be important in hot weather if the car is to be held several days on the receiver's tracks before unloading, it would be sound judgment for the shipper to use stage icing in lieu of full tank service much of the time when standard refrigeration is needed, and have such occasional cars as are to be held several days re-iced with a ton or two of ice after delivery.

Fan cars vs. non-fan cars. There was no great difference in the average temperatures (bottom, middle and top layers) of non-precooled fruit shipped in cars with and without fans, but the temperature spread between the warmest and coolest levels in the non-fan cars was considerably greater than that in the fan cars. The bottom layer in the non-fan cars became unnecessarily cold while the top layer did not cool as rapidly as was desirable. For example, the top of the load in the non-precooled loads in non-fan cars I, J, and L cooled from 14 to 17 degrees during the transit period of 3 to 4 days while that amount of heat was removed from the warmest part of the loads in the non-precooled fan cars, E, H, and K, by evening of the day after loading. The minimum temperatures in the fan cars were higher and the maximum temperatures lower than in non-fan cars receiving the same icing service, thereby giving a more uniform temperature throughout the load in the fan car.

Rind breakdown and decay. Although this test was made with Valencia oranges somewhat past their prime condition, rind breakdown did not develop either during the transit period or during the holding period of 1 week following unloading. The fact that the test lots were given neither the usual ethylene nor the "color-added" treatment may be significant.

There was no clear-cut correlation between temperatures in transit and the development of decay either during or after the transit period in the test lots. Apparently, the transit period was too short for the range of temperatures encountered to have much effect on decay development, about half of which was stem-end rot and half green mold.

SUMMARY

Both item 80, section 2, i.e. one re-icing, and half-stage icing, standard refrigeration gave essentially the same temperatures as did full bunker standard refrigeration service with loads of non-precooled fruit.

On arrival at New York there was enough ice in the bunkers of cars loaded with warm fruit given only one re-icing to maintain satisfactory temperatures for at least a day or two without further re-icing.

Half-stage icing, item 80, section 2, was a satisfactory substitute for the full bunker service in late spring with shipments of room-precooled fruit to markets reached within 3 or 4 days after loading.

Half-stage icing services cost approximately 78 percent of the corresponding full bunker services.

One re-icing during transit was adequate for fruit precooled after loading. When quicker cooling is desired the cars precooled with car fans and ice probably should be re-iced the morning following loading, rather than the second morning.

Fruit in standard nailed crates loaded according to the conventional "Largo" plan, i.e., seven rows on end without stripping between layers, cooled at about the same rate as that in open mesh bags loaded in double-deck cars.

Fan cars produced a more uniform temperature throughout the load than did non-fan cars. The practical advantage of this more uniform temperature rests in a lower maximum temperature in fan cars, hence, less likelihood of decay development. Normally, fan cars can cool the load fast enough to greatly reduce if not eliminate the need for pre-cooling before loading.

No advantage was gained by precooling the Valencia oranges used in this mid-May test. Rind breakdown did not develop in the test lots either during transit or during the holding period of 1 week after unloading. Decay developed in negligible proportions during transit and even during the holding period of 1 week at room temperature rot ranged only from 2.0 to 7.5 percent. There was no clear-cut correlation between decay and temperatures in transit, loading, or packaging methods. About half of the decay was caused by stem-end rot and the other half by green mold.

ACKNOWLEDGMENTS

These tests were made possible by the generous cooperation of the carrying, shipping, and receiving agencies and their several representatives. Acknowledgment is due Fruit Growers Express Company, Florida East Coast, Atlantic Coast Line, Richmond, Fredricksburg and Potomac, Pennsylvania, and New York, New Haven and Hartford Railroads; also, American Fruit Growers, Atlantic Commission Company, Deerfield Growers Company, Egan-Fickett and Company, Felix D'Albora and Company, Florida Citrus Exchange, Ft. Pierce Cooperative, Ft. Pierce Growers Association, Growers Marketing Service, Growers and Shippers League of Florida, Holly-Hill Fruit Products Inc., and Nevins-Ideal Fruit Company for their assistance.

PERSONNEL

United States Department of Agriculture

R. H. Cubbedge	Orlando, Florida
H. P. Danforth, Jr.	Orlando, Florida
B. A. Friedman	New York, New York
H. W. Hruschka	New York, New York
J. Kaufman	New York, New York
G. A. Meckstroth	Orlando, Florida
J. R. Winston	Orlando, Florida

Atlantic Coast Line Railroad

J. W. Hawthorne, General Superintendent	
Motive Power and Equipment	Wilmington, N. C.
B. K. Conrad, Engineer of Tests	Wilmington, N. C.
J. O. Adams, Assistant Freight and Traffic Manager	Orlando, Florida

Florida East Coast Railway

H. E. C. Hawkins, Chief Freight Traffic Officer	St. Augustine, Florida
---	------------------------

Pennsylvania Railroad

P. C. Reed, P. T. M.	New York, New York
G. H. West, District Freight Agent	Jacksonville, Florida

Fruit Growers Express Company

H. A. Black, Supervising Agent	Jacksonville, Florida
F. M. Blakely, Agent	Florence, S. C.
G. B. Herring, Agent	New Smyrna, Florida
W. M. Musselwhite, Agent	Sanford, Florida
M. N. Weatherhead, Assistant Mechanical Engineer	Alexandria, Virginia

TABLE NO. 1

Test 2 - May 1951

LIST OF TEST CARS

Florida Citrus

Car	Type	Loading period	Load	Refrigeration service
A FGE 59625	Standard fan car	11:30A to 2:05P	Oranges 535 1-3/5 bu. standard nail crates	Pre-iced, room precooled, item 80, section 2, re-iced at Florence, S. C., vents closed to destination.
B FGE 57850	Standard non-fan car	9:40A to 10:58A	do	Same as car A, except non-fan.
C FGE 59269	Standard non-fan car	10:25A to 11:45A	Grapefruit 517 1-3/5 bu. standard nail crates	Pre-iced, room precooled, stage icing, item 80, section 2, re-iced at Florence, S. C., vents closed to destination.
D FGE 59609	Standard fan car	10:00A to 11:35A	Grapefruit 512 1-3/5 bu. standard nail crates	Same as car A, except precooled in car by means of ice and Preco car fans.
E FGE 59585	Standard fan car	10:05A to 10:00P	Grapefruit 487 1-3/5 bu. standard nail crates	Same as car A, except not precooled. ^{1/}
F FDE 9310	Double deck non-fan car	8:30A to 2:30P	Oranges 8576 5 lb. open mesh bags	Bunkers dry, vents closed, precooled in car with truck mounted unit, initially iced 9600 lbs., item 80, section 2, re-iced at Florence, S. C., vents closed to destination.

^{1/} The original plan called for precooling this car after loading and re-icing it at Jacksonville. Loading was not completed until train departure time.

Table No. 1 (Continued)

Florida Citrus List of Test Cars Test 2 - May 1951

Car	Type	Loading period	Load	Refrigeration service
G FDE 9073	Double deck fan car	8:00A to 11:25A	Oranges 8576 5 lb. open mesh bags	Same as car A, except precooled in car.
H FGE 56294	Standard fan car	9:15A to 1:30P	Oranges & Grapefruit 517 1-3/5 bu. standard nail crates	Same as car A, except non-precooled fruit.
I FGE 59186	Standard non-fan car	2:00P to 3:50P	Grapefruit 500 1-3/5 bu. standard nail crates	Same as car A, except non-precooled fruit.
J FGE 59086	Standard non-fan car	3:00P to 8:45P	Oranges 480 1-3/5 bu. standard nail crates	Pre-iced, standard refrigeration; vents closed to destination
K FGE 56255	Standard fan car	2:35P to 4:10P	Grapefruit 511 1-3/5 bu. standard nail crates	Pre-iced, stage icing, standard refrigeration; vents closed to destination.
L FGE 57584	Standard non-fan car	10:00A to 2:00P	Grapefruit 512 1-3/5 bu. standard nail crates	Same as car K.

TABLE NO. 2

AVERAGE TEMPERATURES IN TRANSIT

Florida Citrus

Test 2 - May 1951

Car: Type: Protective service:	Precooled				In car				Not precooled				
	A	B	C	F	G	D	E	H	I	J	K	L	
	Fan	NF 1/	NF	NF DD 2/	Fan DD	Fan	Fan	Fan	NF	NF	Fan	NF	
	80-2 3/	80-2	U/2 4/	80-2	80-2	80-2	80-2	80-2	80-2	St.R 5/	U/2	U/2	
			80-2								St.R	St.R	
Location	Date												
May													
Loading	17	412	466	472	789	740	712	723	747	749	727	735	720
End of precooling	17	---	---	---	601 6/	580 6/	591 6/	---	---	---	---	---	---
Sanford, Fla.	18	---	---	---	649	559	---	---	---	---	---	---	---
New Smyrna, Fla.	18	414	455	459	---	---	565	633	629	654	635	674	662
Jacksonville, Fla.	18	424	456	464	634	557	567	619	617	654	608	614	631
Savannah, Ga.	18	420	462	470	635	564	558	592	600	633	575	601	615
Florence, S. C.	19	412	461	470	605	560	560	572	596	627	559	579	607
Rocky Mount, N. C.	19	404	454	462	588	494	503	516	525	595	522	535	578
Richmond, Va.	19	401	454	458	573	480	485	491	503	587	505	516	565
Potomac Yards, Va.	19	399	453	453	551	476	469	479	486	570	496	514	562
Destination	20	---	---	---	---	---	451 7/	451	---	529	456	479	---
Destination	21	415	439	447	538	471	450	---	469	---	---	---	507
Destination	21	426	440	449	---	---	---	---	476	---	---	---	---
Temp. reduction g/		+03	27	25	251	269	261	272	278	220	271	256	213
Average 2/		411	456	462	618	545	541	564	575	622	565	583	605

1/ NF signifies a non-fan car.

2/ NFDD signifies a double deck non-fan car.

3/ 80-2 signifies Item 80, Section 2.

4/ U/2 signifies stage or upper half tank icing.

5/ St.R signifies Standard Refrigeration.

6/ Not included in averages.

7/ Car D unloaded at Philadelphia; all other cars unloaded at New York City area.

8/ Temperature reduction from loading until arrival at destination.

9/ Terminates with the first readings at destination.

TABLE NO. 3

CONSOLIDATED FRUIT TEMPERATURES
COMPARISON OF ICING SERVICES AND OF TYPES OF CARS

Florida Citrus		NON-PRECOOLED LOADS										Test 2 - May 1951	
		Standard Refrigeration		Item 80, Sec. 2		Non-fan Service		Fan Service					
Station	Date	Hour	Average		Max. ^{3/}	Min. ^{2/}	Average		Max. ^{1/}	Min. ^{1/}	Average		Max. ^{1/}
			J, K, L ^{1/}	E, H, I			J, K, L ^{1/}	E, H, I			I, J, L	E, H, K	
	May												
At loading	17		727	727	727		740	740	732	732	735	735	735
New Smyrna, Fla.	18	5:45A	657	579	708		639	579	679	712	645	610	675
Jacksonville, Fla.	18	11:45A	618	531	679		630	574	664	701	617	596	642
Jacksonville, Fla.	18	5:15P	610	514	679		623	547	664	695	614	566	648
Savannah, Ga.	18	10:00P	597	510	659		608	559	641	687	598	586	613
Florence, S. C.	19	4:30A	582	498	644		598	551	628	675	582	571	597
Rocky Mount, N. C.	19	12:45P	545	457	616		545	499	579	643	525	501	552
Richmond, Va.	19	4:45P	529	445	598		527	471	570	638	503	477	531
Potomac Yards, Va.	19	10:15P	524	449	592		512	459	549	627	493	474	514
Destination	21	12:00N	468	423	540		490	433	515	573	465	449	482
Average temperature (10 readings)			586	513	644		591	541	625	668	578	556	599
Reduction in temperature during transit			259	304	187		250	307	225	239	325	270	286
													253

1/ Grand average from 9 positions each car.

2/ Average minimum from 3 positions on same level in each car.

3/ Average maximum from 3 positions on same level in each car.

ICING AND BUNKER INSPECTION RECORD

Florida Citrus

Test 2 - May 1951

LOCATION	HOUR	DATE	CAR, TYPE AND TREATMENT							
			A	B	C	D	E	F		
			Fans "ON" Full Bunker	Non-fan Full Bunker	Non-fan Half Stage	Fans "ON" Full Bunker	Fans "ON" Full Bunker	Non-fan Double Deck Full Bunker		
			Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Pre-iced at New Smyrna	5:30P	May 16	9,600	9,600	4,800	9,600	9,600			
Pre-iced at Ft. Pierce	5:30P	16	-----	-----	-----	-----	-----	-----	-----	-----
Pre-iced at Sanford	5:05P	16	-----	-----	-----	-----	-----	-----	-----	-----
Initially iced at Sanford	8:35A	18	-----	-----	-----	-----	-----	-----	9,600	
Re-iced at New Smyrna	7:30A	18	-----	-----	-----	-----	-----	-----	-----	-----
Re-iced at Florence	5:50A	19	4,000	3,600	2,800	9,400	9,000		3,600	
Ice Remaining at Potomac Yards	10:00P	19	7,900	8,600	3,800	6,000	5,400		6,000	
Re-iced at Potomac Yards	11:50P	19	-----	-----	-----	-----	-----	-----	-----	-----
Total Ice Supplied to Destination			13,600	13,200	7,600	19,000	18,600		13,200	
Ice Melted to Destination			7,700	6,000	5,200	14,600	13,800		11,100	
Ice Supplied at Destination	4:10P	21	-----	-----	-----	-----	-----	-----	-----	-----
	1:40P	22	-----	-----	-----	-----	-----	-----	-----	-----
Ice Remaining at Unloading		20	-----	-----	-----	-----	4,800		-----	-----
		21	5,800	6,700	2,000	4,400 1/	-----		2,100	
		22	-----	-----	-----	-----	-----		-----	-----

1/ This car was unloaded at Philadelphia.

TABLE NO. 4 (continued)
ICING AND BUNKER INSPECTION RECORDFlorida Citrus
Test 2 - May 1951

CAR, TYPE AND TREATMENT

LOCATION	HOUR	DATE	G		H		I		J		K		L	
			Fans "ON" Double Deck Full Bunker	Pounds	Fans "ON" Full Bunker	Pounds	Non-fan Full Bunker	Pounds	Non-fan Full Bunker	Pounds	Fans "ON" Half Stage	Pounds	Non-fan Half Stage	Pounds
Pre-iced at New Smyrna	5:30P	16	-----	Pounds	10,000	Pounds	-----	9,600	Pounds	-----	4,800	Pounds	-----	4,800
Pre-iced at Ft. Pierce	5:30P	16	-----	-----	-----	-----	9,600	-----	-----	-----	-----	-----	-----	-----
Pre-iced at Sanford	5:05P	16	9,600	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Initially iced at Sanford	8:35A	18	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Re-iced at New Smyrna	7:30A	18	-----	-----	-----	-----	-----	-----	4,800	4,000	4,200	-----	4,200	-----
Re-iced at Florence	5:50A	19	9,400	-----	9,600	6,600	6,600	4,000	4,000	4,600	2,800	-----	2,800	-----
Ice Remaining at Potomac Yards	10:00P	19	5,800	-----	4,900	6,600	6,600	6,300	6,300	1,800	2,600	-----	2,600	-----
Re-iced at Potomac Yards	11:50P	19	-----	-----	-----	-----	-----	-----	3,300	3,000	2,200	-----	2,200	-----
Total Ice Supplied to Destination			19,000	-----	19,600	16,200	16,200	21,700	21,700	16,400	14,000	-----	14,000	-----
Ice Melted to Destination			15,200	-----	16,600	11,400	11,400	15,500	15,500	14,000	12,800	-----	12,800	-----
Ice Supplied at Destination	4:10P 1:40P	21 22	----- -----	-----	-----	-----	-----	-----	-----	-----	4,500	-----	4,500	-----
Ice Remaining at Unloading		20 21 22	----- 3,800 -----	-----	----- 3,000 -----	4,800 ----- -----	4,800	6,200	6,200	2,400	-----	-----	-----	3,000

SUMMARY TABLE 5

ICE MELTAGE IN RELATION TO TEMPERATURE REDUCTION DURING TRANSIT COMPARISON OF ICING SERVICES AND TYPES OF CARS

Florida Citrus

Test 2 - May 1951

	COMPARISON OF ICING SERVICES		COMPARISON OF CAR TYPES	
	Standard Refrigeration Cars J, K, L ^{1/}	Item 80, Section 2 Cars E, H, I	Non-fan Service Cars I, J, L ^{2/}	Fan Service Cars E, H, K ^{2/}
Pounds				
Ice supplied	17,367	18,133	17,300	18,200
Ice remaining at destination ^{1/}	3,267	4,300	4,067	3,500
Ice melted to destination	14,100	13,833	13,233	14,700
Total heat removed to destination	24.7°	25.7°	23.5°	26.9°
Average transit temperature of commodity	58.4°	58.7°	59.7°	54.1°

^{1/} Includes two cars given stage icing.

^{2/} Includes one car given stage icing.

^{3/} Soon after arrival at Jersey City area.

TABLE NO. 6

DEVELOPMENT OF RIND BREAKDOWN AND DECAY IN
NATURAL COLOR U.S. NO. 2 VALENCIA ORANGES, SIZE 200

Florida Citrus Test 2 - May 1951

CAR	Time Interval 1/	First Inspection			+ 1 week at room temperatures				
		RB 2/	DK	SER	GM	Total			
						RB 2/	DK 3/	SER 3/	GM 3/
Days									
A	5	0	0.5	0.5	0	0	2.0	1.0	1.0
B	5	0	0.5	0	0.5	0	2.0	0	2.0
C	5	0	0.5	4/	0	0	4.5	1.5	2.5
D	4	-	---	-	-	-	---	---	---
E	4	0	0.5	0.5	0	0	7.5	3.5	4.0
F 7/	5	0	1.0	1.0	0	0	21.0	19.0	2.0
G	5	0	0.5	0.5	0	0	6.5	3.5	3.0
H	5	0	1.0	0	1.0	0	6.0	2.5	3.5
I	4	0	0	0	0	0	7.5	5.5	2.0
J	4	0	0.5	0	0.5	0	6.5	3.5	3.0
K	4	0	0	0	0	0	5.5	4.5	1.0
L	6	0	1.5	0.5	1.0	0	4.0	2.5	1.5
Range	-	-	0-1.5	---	---	-	2.0-7.5	---	---
Average	4.6	0	0.6 5/	0.2	0.3	0	5.2	2.8	2.4

1/ Time from loading date to first inspection at destination.

2/ Includes aging and pitting of commercial importance.

3/ Cumulatively.

4/ Alternaria rot.

5/ Alternaria rot was responsible for part of this total.

6/ Car D diverted to Philadelphia, no inspection made of test fruit.

7/ Car F not included in averages.

KEY:

RB signifies Rind Breakdown

SER signifies Stem End Rot

GM signifies Green Mold

DK signifies Decay

Table 1

CAR A
TEMPERATURES IN TRANSITMay, 1951-A
Oranges
Billing Weight - 53500

535 boxes

FGE 59625, Fans On

Preiced, Item 80, Section 2. Precooled in room; reiced Florence.

Place	Date May	Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	TD ES	Bot AVG	Mid AVG	Top AVG	Grand AVG
Preiced at New Smyrna, May 16 at 5:30 P.M.																			
Fort Pierce, Fla.	17	2:10P	78	660	356	412	429	422	417	422	452	493	498	518	548	421	430	514	461
Fort Pierce, Fla.	17	8:15P	73	560	356	392	414	412	412	412	427	458	478	498	508	406	417	486	441
New Smyrna, Fla.	18	5:45A	70	440	396	---	409	417	402	407	427	413	408	---	428	413	412	416	414
Jacksonville, Fla.	18	11:45A	85	490	396	---	414	432	412	412	437	418	418	438	438	423	420	428	424
Jacksonville, Fla.	18	5:15P	79	600	366	---	414	422	412	412	427	438	468	468	478	418	417	463	438
Savannah, Ga.	18	10:00P	72	460	406	---	414	432	402	412	427	418	418	---	438	423	414	425	420
Florence, S. C.	19	4:30A	57	430	406	---	404	422	402	412	427	408	398	---	423	413	414	410	412
Reiced at Florence																			
Rocky Mount, N. C.	19	12:45P	64	400	386	422	404	422	402	402	417	388	378	398	408	416	407	393	404
Richmond, Va.	19	4:45P	60	420	386	---	404	422	402	392	417	388	388	---	398	413	404	391	401
Potomac Yards, Va.	19	10:15P	61	430	376	---	394	412	392	392	417	388	388	398	408	403	400	396	399
Harsimus Cove, N. J.	21	10:00A	66	460	356	---	399	417	402	397	417	408	423	428	443	408	405	426	415
Pier 29, New York C.	21	7:15P	73	560	356	422	394	422	402	392	417	438	468	448	458	413	404	453	426

Notes:

OST - outside temperature
 BB - bottom bunker
 CL - centerline
 BQ - bottom quarterlength
 BD - bottom doorway
 MB - middle bunker

MQ - middle quarterlength
 MD - middle door
 TB - top bunker
 TQ - top quarterlength
 TD - top doorway
 TDES - top door, east side, not included in averages

Average temperature of fruit entering the car during the loading period was 412.



Table 8

CAR B
TEMPERATURES IN TRANSIT

May, 1951-B
Oranges
Billing Weight - 53500

FGE 57850, No Fan

Preiced, Item 80, Section 2. Precooled in room; reiced Florence.

Place	Date	Time	OST	Top Air	Bot Air	BB	BQ	BD	MB	MQ	MD	TB	TQ	TD	TD	ES	Bot	Mid	Top	Grand
	May					CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
Preiced at New Smyrna, May 16 at 5:30 P.M.																				
Fort Pierce, Fla.	17	12:20P	68	542	366	452	467	492	492	474	417	498	510	487	522	487	470	461	504	481
Fort Pierce, Fla.	17	8:15P	73	532	366	422	447	462	467	464	427	488	500	507	512	507	444	453	502	470
New Smyrna, Fla.	18	5:45A	70	512	356	402	417	442	447	454	427	478	490	507	482	507	420	443	489	455
Jacksonville, Fla.	18	11:45A	85	547	366	397	417	437	447	454	437	478	495	517	482	517	417	446	493	456
Jacksonville, Fla.	18	5:15P	79	592	366	402	417	442	447	464	437	488	500	527	482	527	420	449	499	461
Savannah, Ga.	18	10:00P	72	582	366	392	417	442	447	454	447	488	510	537	482	537	417	449	504	462
Florence, S. C.	19	4:30A	57	542	361	392	407	442	442	454	447	498	510	537	482	537	414	448	507	461
Reiced at Florence																				
Rocky Mount, N. C.	19	12:45P	64	512	356	382	407	432	437	444	447	478	500	527	482	527	407	443	497	454
Richmond, Va.	19	4:45P	60	512	356	382	407	432	437	444	447	478	500	527	482	527	407	443	497	454
Potomac Yards, Va.	19	10:15P	61	512	356	382	397	432	437	444	447	478	500	527	482	527	404	443	497	453
Harsimus Cove, N. J.	21	10:00A	66	502	356	362	387	412	417	429	437	468	490	517	467	517	387	428	486	439
Pier 29, New York C.	21	7:15P	73	562	356	362	387	412	417	424	437	478	490	517	472	517	387	426	489	440

Average temperature of fruit entering the car during the loading period was 466.



Table 9

CAR C
TEMPERATURES IN TRANSIT

May, 1951-C
Grapefruit
Billing Weight - 47047

517 boxes

FGE 59269, No Fan

Preiced; half stage; Item 80, Section 2; Precooled in room; Reiced Florence.

Place	Date May	Time	OST	Top		Bot	BB	BQ	BD	MB	MQ	MD	TB		TQ	TD	TD	ES	Bot AVG	Mid AVG	Top AVG	Grand AVG
				Air	CL								CL	CL								
Preiced at New Smyrna, May 16 at 5:30 P.M.																						
Fort Pierce, Fla.	17	12:15P	68	548	387	477	457	462	459	487	487	487	496	496	492	497	477	477	465	478	491	479
Fort Pierce, Fla.	17	8:15P	73	513	377	427	432	442	439	512	467	467	486	486	482	487	512	512	434	473	492	469
New Smyrna, Fla.	18	5:45A	70	503	377	407	422	432	429	502	457	457	466	466	482	477	512	512	420	463	484	459
Jacksonville, Fla.	18	11:45A	85	523	382	407	422	442	434	502	462	462	476	476	487	482	522	522	424	466	492	464
Jacksonville, Fla.	18	5:15P	79	553	387	407	432	442	439	502	457	457	486	486	492	487	532	532	427	466	499	468
Savannah, Ga.	18	10:00P	72	553	387	412	432	442	439	502	462	462	496	496	497	487	532	532	429	468	503	470
Florence, S. C.	19	4:30A	57	533	387	412	432	447	439	507	457	457	496	496	492	487	532	532	430	468	502	470
Reiced at Florence																						
Rocky Mount, N. C.	19	12:45P	64	503	367	397	412	432	439	492	457	457	476	476	492	487	532	532	414	463	497	462
Richmond, Va.	19	4:45P	60	503	367	387	412	432	439	492	457	457	476	476	482	477	522	522	410	463	489	458
Potomac Yards, Va.	19	10:15P	61	493	367	387	402	422	429	482	457	457	466	466	482	477	522	522	404	456	487	453
Harsimus Cove, N. J.	21	10:00A	66	493	367	382	397	417	419	452	447	447	461	461	472	517	502	502	399	439	488	447
Pier 29, New York C.	21	7:15P	73	633	377	377	392	412	419	442	437	437	486	486	492	517	512	512	394	433	502	449

Average temperature of fruit entering the car during the loading period was 472.



CAR D

TEMPERATURES DURING PRECOOLING

Table 10

WITH ICE AND PORTABLE ELECTRIC MOTORS AND PRECO FANS

512 Boxes Grapefruit

Billing Weight - 46592

ON FGE 59609

May 17, 1951-D
Ft. Pierce, Florida

Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	TD ES	Bot Avg	Mid Avg	Top Avg	Grand Avg
12 Noon	68	645	416	645	687	705	715	726	715	706	725	717	717	679	719	716	705
Fans non-operating from 12:05 P.M. to 2:15 P.M.																	
2:20P	78	545	561	585	667	675	685	711	700	676	695	692	697	642	699	688	676
3:20P	78	495	626	595	662	670	650	666	665	626	625	627	637	642	661	626	643
4:20P	78	515	626	605	657	665	625	656	645	606	605	607	607	642	642	606	630
5:20P	76	535	626	605	657	665	615	646	635	596	585	587	592	642	632	589	621
6:20P	73	525	606	605	647	655	600	626	625	576	565	567	577	636	617	569	607
7:20P	73	525	606	605	637	645	585	606	605	566	555	557	567	629	599	559	596
7:55P	66	505	586	605	637	645	585	606	605	561	550	552	562	629	599	554	594

Average temperature of fruit entering the car during the loading period was 712

CAR D

TEMPERATURES IN TRANSIT

May, 1951-D
Grapefruit
Billing Weight = 46592

Table 11

512 boxes

FGE 59609, Fans On

Preciced, Item 80, Section 2. Precooled in car with Preco Fans; reiced Florence.

Place	Date	Time	OST	Top Air	Bot Air	BB	BQ	BD	MB	MQ	MD	TB	TQ	TD	TD	ES	Bot Avg	Mid Avg	Top Avg	Grand Avg
Fort Pierce, Fla.	17	12:00N	68	645	416	645	687	705	715	727	715	706	725	717	717	717	679	719	716	706
Preiced at New Smyrna, May 16 at 5:30 P.M.																				
Precooled 6 hours in car																				
Fort Pierce, Fla	17	7:55P	66	505	586	605	637	645	585	607	605	561	550	552	562	562	629	599	556	591
New Smyrna, Fla.	18	5:45A	70	525	466	555	607	605	555	587	575	536	535	547	547	547	589	572	541	565
Jacksonville, Fla.	18	11:45A	85	545	486	555	597	605	565	587	575	546	535	552	552	552	586	576	546	567
Jacksonville, Fla.	18	5:15P	79	645	436	545	587	585	565	587	585	566	555	557	567	572	572	579	561	570
Savannah, Ge.	18	10:00P	72	545	486	555	577	585	545	557	565	546	535	547	567	572	572	556	549	558
Florence, S. C.	19	4:30A	57	565	516	565	567	575	555	557	565	546	545	557	567	567	569	559	554	560
Reiced at Florence																				
Rocky Mount, N. C.	19	12:45P	64	435	406	515	547	545	505	507	515	486	455	477	477	477	536	509	474	503
Richmond, Va.	19	4:45P	60	425	406	505	527	535	485	487	495	466	445	457	447	447	522	489	454	485
Potomac Yards, Va.	19	10:15P	61	455	366	475	497	515	465	477	485	446	435	447	447	447	496	476	444	469
Philadelphia, Pa.	20	9:00P	65	475	351	425	457	475	440	457	470	441	435	447	467	467	452	456	448	451
Philadelphia, Pa.	21	2:30A	64	475	346	410	452	470	435	457	470	446	440	447	472	472	444	454	451	450

Average temperature of fruit entering the car during the loading period was 712.



CAR E

May, 1951-E
Grapefruit
Billing Weight - 44317

TEMPERATURES IN TRANSIT

Table 12

487 boxes

FGE 59585, Fans On

Preiced, Item 80, Section 2; reiced Florence.

Place	Date	Time	OST	Top Air	Bot Air	BB	BQ	BD	MB	MQ	MD	TB	TQ	TD	CL	ES	Bot	Mid	Top	Grand
	May					CL	CL	CL	CL	CL	CL	CL	CL	CL	CL		AVG	AVG	AVG	AVG
Preiced at New Smyrna, May 16 at 5:30 P.M.																				
Fort Pierce, Fla.	17	9:30P	72	726	425	526	573	737	697	717	736	705	730	757	741	757	612	717	733	692
New Smyrna, Fla.	18	5:45A	70	546	515	546	623	667	647	657	636	615	635	657	646	657	612	647	638	633
Jacksonville, Fla.	18	11:45A	85	576	495	556	623	647	627	637	606	615	615	637	626	637	609	623	623	619
Jacksonville, Fla.	18	5:15P	79	656	415	516	583	617	617	647	616	615	615	647	626	647	572	627	626	610
Savannah, Ga.	18	4:00P	72	556	505	556	603	607	---	617	576	575	585	617	596	617	589	597	593	592
Florence, S. C.	19	4:30A	57	556	505	556	583	587	---	577	566	555	565	587	576	587	575	572	571	572
Reiced at Florence																				
Rocky Mount, N. C.	19	12:45P	64	426	425	516	543	547	---	517	496	495	495	527	506	527	535	507	506	516
Richmond, Va.	19	4:45P	60	426	425	506	523	527	---	497	466	475	455	497	476	497	519	482	476	491
Potomac Yards, Va.	19	10:15P	61	466	375	476	503	507	---	487	456	465	455	487	476	487	495	472	471	479
Pier 29, New York C.	20	10:00P	60	466	355	426	463	467	---	457	446	435	445	467	456	467	452	452	451	451

Average temperature of fruit entering the car during the loading period was 723.



CAR F

Table 13

TEMPERATURES DURING PRECOOLING

Oranges

8576 - 5 lb. open mesh bags

Billing Weight - 48026

WITH TRUCK MOUNTED MECHANICAL PRECOOLING UNIT

FDE 9310

May 17, 1951-F
Leesburg, Florida

Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	XQ CL	Bot Avg	Mid Avg	Top Avg	Grand Avg
2:30P	82	---	770	750	789	797	770	799	802	782	777	822	809	779	790	794	788
Changed precooling unit at 3:10 P.M.																	
3:30P	77	---	705	740	794	802	765	794	792	747	727	772	804	779	784	749	770
4:30P	76	---	600	715	---	767	750	779	767	677	647	657	774	741	765	660	720
5:30P	80	---	565	680	---	752	725	749	757	632	617	622	764	716	744	624	692
6:30P	77	---	535	650	---	727	710	739	717	582	572	567	724	689	722	574	658
7:30P	73	---	505	625	---	697	685	734	687	552	542	542	704	651	702	545	633
8:30P	70	---	505	595	---	682	675	714	672	527	517	512	674	639	687	519	612
9:00P	70	---	495	590	---	667	665	709	647	517	507	502	664	629	674	509	601

Defrosted for 15 minutes at 4:30 P.M., 6:30 P.M., and 8:30 P.M.

Average temperature of fruit entering the car during the loading period was 789.

CAR G

TEMPERATURES DURING PRECOOLING

Table 15

WITH ICE AND PORTABLE ELECTRIC MOTORS AND PRECO FANS

May 17, 1951-G
Davenport, Florida

8576 5-lb. open mesh bags
Billing Weight - 48026

ON FDE 9073

Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	XQ CL	Bot Avg	Mid Avg	Top Avg	Grand Avg
11:25A	78	739	369	603	687	700	707	727	722	707	775	710	-	663	719	731	703
Fans started at 11:30 A.M.																	
12:30P	76	509	644	598	722	690	687	712	687	587	690	645	-	670	695	641	669
1:30P	76	499	644	593	702	660	662	692	657	557	605	585	-	652	670	582	635
2:30P	78	494	634	583	697	640	657	682	637	527	570	565	-	640	659	554	618
3:30P	79	489	624	573	692	620	647	677	617	517	550	550	-	628	647	539	605
4:30P	76	489	614	573	672	610	632	657	602	517	550	550	-	618	630	539	596
5:30P	76	489	614	568	672	585	607	667	577	492	510	545	-	608	617	516	580

Average temperature of fruit entering the car during the loading period was 740.



CAR G

Table 16

TEMPERATURES IN TRANSIT

May, 1951-G
Oranges
Billing Weight - 48026

8576 5-lb. open-mesh bags Double-deck - FDE 9073, Fans On

Preiced, Item 80, Section 2. Precooled in car with Preco Fans; reiced Florence.

Place	Date May	Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	Bot Avg	Mid Avg	Top Grand Avg
Davenport, Fla.	17	11:25A	78	739	369	603	687	700	707	727	722	707	775	710	663	719	731 703
				Preiced at Sanford, May 16 at 5:07 P.M.													
				Precooled 6 hours in car													
Davenport, Fla.	17	5:30P	76	489	614	568	672	585	607	667	577	492	510	545	608	617	516 580
Sanford, Fla.	18	5:30A	61	604	389	483	612	560	567	612	557	547	555	540	552	579	547 559
Jacksonville, Fla.	18	2:30P	80	604	394	488	612	550	572	612	547	552	550	530	550	577	544 557
Savannah, Ga.	18	10:00P	72	584	454	508	612	540	582	622	577	537	550	545	553	594	544 564
Florence, S. C.	19	4:30A	57	574	474	528	602	540	572	612	557	537	540	555	557	580	544 560
				Reiced at Florence													
Rocky Mount, N. C.	19	12:45P	64	484	394	478	542	480	542	582	497	407	470	445	500	540	441 494
Richmond, Va.	19	4:45P	60	474	404	468	512	460	542	572	467	417	450	435	480	527	434 480
Potomac Yards, Va.	19	10:15P	61	504	364	448	512	450	552	542	447	437	460	435	470	514	444 476
Harlem River, N. Y.	21	11:00A	66	554	344	388	472	430	532	502	447	487	510	475	430	494	491 471

Average temperature of fruit entering the car during the loading period was 740.



CAR H

TEMPERATURES IN TRANSIT

May, 1951-H
Oranges and Grapefruit
Billing Weight - 49720

FGE 56294, Fans On

Table 17

517 boxes

Preiced, Item 80, Section 2; reiced Florence.

Place	Date	Time	OST	Top Air	Bot Air	BB	BB	BQ	BD	MB	MQ	MD	TB	TQ	TD	TD	ES	Bot	Mid	Top	Grand
	May			Air	Air	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	AVG	AVG	AVG	AVG
Preiced at New Smyrna, May 16 at 5:30 P.M.																					
Fort Pierce, Fla.	17	1:30P	75	708	398	568	628	643	732	738	738	727	754	737	741	725	613	732	739	699	
Fort Pierce, Fla.	17	4:00P	76	728	408	518	568	603	722	738	738	727	754	747	741	735	563	729	744	685	
Fort Pierce, Fla.	17	8:15P	73	728	418	478	538	573	712	738	738	717	754	757	761	745	530	722	754	677	
New Smyrna, Fla.	18	5:45A	70	583	458	518	608	613	632	688	667	667	664	637	651	615	580	662	642	629	
Jacksonville, Fla.	18	11:45A	85	588	468	548	608	623	612	673	642	647	624	617	621	605	593	642	617	617	
Jacksonville, Fla.	18	5:15P	79	578	418	518	568	593	612	668	647	647	634	627	631	645	560	642	634	614	
Savannah, Ga.	18	10:00P	72	588	508	558	608	608	592	633	617	617	594	587	601	600	591	614	596	600	
Florence, S. C.	19	4:30A	57	598	533	578	608	603	592	613	597	597	594	587	591	595	596	601	592	596	
Reiced at Florence																					
Rocky Mount, N. C.	19	12:45P	64	448	418	518	548	553	532	558	537	537	514	497	511	485	540	542	502	525	
Richmond, Va.	19	4:45P	60	448	408	508	538	523	502	538	507	507	494	477	481	465	523	516	479	503	
Potomac Yards, Va.	19	10:15P	61	458	378	478	508	503	492	518	487	487	479	457	471	465	496	499	468	486	
Harsimus Cove, N. J.	21	10:00A	66	503	363	408	438	463	467	498	482	482	479	472	476	505	436	482	483	469	
Pier 29, New York C.	21	7:15P	73	638	378	408	438	463	472	498	487	487	514	507	501	--	436	486	537	476	

Average temperature of fruit entering the car during the loading period was 74.7.



CAR I

Table 18

TEMPERATURES IN TRANSIT

May, 1951-I
Grapefruit
Billing Weight - 45500

FGE 59186, No Jan

500 boxes

Priced, Item 80, Section 2; reiced Florence.

Place	Date May	Time	OST	Top Air	Bot Air	BB CL	BQ CL	BD CL	MB CL	MQ CL	MD CL	TB CL	TQ CL	TD CL	TD PS	Bot AVE	Mid AVE	Top AVE	Grand AVE
Priced at New Smyrna, May 16 at 5:30 P.M.																			
Fort Pierce, Fla.	17	4:00P	76	729	409	684	704	734	742	749	752	754	739	759	754	707	748	752	737
Fort Pierce, Fla.	17	8:15P	73	739	424	614	639	684	722	749	742	754	749	769	754	646	738	757	718
New Smyrna, Fla.	18	5:45A	70	709	414	504	549	584	652	709	692	734	719	739	714	546	684	727	654
Jacksonville, Fla.	18	11:45A	85	719	414	484	524	554	677	709	682	734	709	739	724	521	689	727	654
Jacksonville, Fla.	18	5:15P	79	729	414	474	509	544	662	699	672	724	709	729	724	509	678	722	645
Savannah, Ga.	18	10:00P	72	719	404	464	499	524	652	679	662	719	699	719	714	496	664	713	633
Florence, S. C.	19	4:30A	57	699	394	454	499	514	652	679	642	714	699	709	704	489	658	707	627
Reiced at Florence																			
Rocky Mount, N. C.	19	12:45P	64	639	424	464	489	514	602	629	612	664	649	669	654	489	614	659	595
Richmond, Va.	19	4:45P	60	639	384	424	459	494	582	629	602	684	659	679	654	459	604	669	587
Potomac Yards, Va.	19	10:15P	61	629	374	404	439	474	572	609	582	664	649	659	644	439	588	654	570
Pier 29, New York C.	20	10:00P	60	599	354	374	409	454	522	559	532	614	609	609	614	412	538	609	529

Average temperature of fruit entering the car during the loading period was 749.



CAR J

TEMPERATURES IN TRANSIT

May, 1951-J
Oranges
Billing Weight - 48000

Table 19

480 boxes

FGE 59086, No Fan

Preiced; standard refrigeration

Place	Date	Time	OST	Top Air	Bot Air	BB	BQ	BD	MB	MQ	MD	TB	TQ	TD	TD	ES	Bot	Mid	Top
	May																		
Preiced at New Smyrna, May 16 at 5:30 P.M.																			
Fort Pierce, Fla.	17	8:30P	75	715	405	477	650	670	697	705	747	699	740	725	737	737	599	716	725
New Smyrna, Fla.	18	5:45A	70	705	455	427	550	530	657	665	677	689	720	715	717	717	502	666	710
Reiced at New Smyrna																			
Jacksonville, Fla.	18	11:45A	85	685	415	387	505	480	637	635	647	674	705	705	707	707	457	640	698
Jacksonville, Fla.	18	5:15P	79	685	425	377	480	460	617	585	617	659	690	695	697	697	439	606	685
Savannah, Ga.	18	10:00P	72	665	425	377	470	440	597	565	597	654	680	685	682	682	429	586	575
Florence, S. C.	19	4:30A	57	655	425	367	460	430	577	545	577	639	660	665	667	667	419	566	559
Reiced at Florence																			
Rocky Mount, N. C.	19	12:45P	64	615	385	347	410	410	547	455	537	609	640	635	627	627	389	513	628
Richmond, Va.	19	4:45P	60	605	405	347	420	400	532	355	527	599	630	625	617	617	389	471	618
Potomac Yards, Va.	19	10:15P	61	595	445	347	420	390	517	345	507	589	620	615	607	607	386	456	608
Reiced at Potomac Yards																			
Pier 29, New York C.	20	10:00P	60	545	455	327	390	371	457	335	457	539	560	565	557	557	362	416	555
																			456

Average temperature of fruit entering the car during the loading period was 727.



Table 20

CAR K

TEMPERATURES IN TRANSIT

May, 1951-K
Grapefruit
Billing Weight - 46501

511 boxes

FGE 56255, Fans On

Preiced; half stage; standard refrigeration

Place	Date	May	Time	OST	Top Air	Bot Air	BB	BQ	BD	MB	MQ	MD	TB	TQ	TD	TD	ES	Bot Avg	Mid Avg	Top Grand Avg
Preiced at New Smyrna, May 16 at 5:30 P.M.																				
Wabasso, Fla.	17		4:10P	79	745	445	692	686	710	765	730	788	740	765	750	740	696	761	750	737
New Smyrna, Fla.	18		5:45A	70	665	520	612	641	660	705	685	758	670	655	670	680	638	716	669	674
Reiced at New Smyrna																				
Jacksonville, Fla.	18		11:45A	85	565	400	572	616	620	650	615	718	610	560	585	590	603	661	586	614
Jacksonville, Fla.	18		5:15P	79	655	395	522	576	600	645	640	738	610	595	620	630	566	674	614	618
Savannah, Ga.	18		10:00P	72	535	465	562	596	650	615	570	698	580	565	580	590	603	628	579	601
Florence, S. C.	19		4:30A	57	555	475	562	584	600	585	560	698	550	535	550	570	582	614	551	579
Reiced at Florence																				
Rocky Mount, N. C.	19		12:45P	64	425	405	522	556	570	555	510	658	510	475	490	500	549	579	494	535
Richmond, Va.	19		4:45P	60	465	415	512	536	550	525	490	638	480	455	480	490	533	551	476	516
Potomac Yards, Va.	19		10:15P	61	505	385	502	516	540	525	490	628	480	475	480	500	519	548	484	514
Reiced at Potomac Yards																				
Pier 29, New York C.	20		10:00P	60	495	355	442	476	490	485	470	578	440	455	460	490	469	511	461	479

Average temperature of fruit entering the car during the loading period was 735.



CAR L

TEMPERATURES IN TRANSIT

May, 1951-L
Grapefruit
Billing Weight - 46592

FGE 57584, No Ten

Preiced; half stage; standard refrigeration.

Place	Date May	Time	OST	Top Air	Bot Air	Priced at New Smyrna, May 16 at 5:30 P.M.												TD ES	Bot Avg	Mid Avg	Top Avg	Grand Avg
						BB	BQ	CL	BD	MB	MQ	MD	TB	CL	TQ	CL	TD					
Fort Pierce, Fla.	17	2:00P	78	715	476	715	712	705	692	715	796	730	732	732	750	711	734	736	728			
Fort Pierce, Fla.	17	8:15P	73	715	506	625	602	605	652	705	766	710	722	732	710	611	708	719	683			
New Smyrna, Fla.	18	5:45A	70	685	526	590	612	585	632	675	736	690	702	712	690	596	681	699	662			
Reiced at New Smyrna																						
Jacksonville, Fla.	18	11:45A	85	660	416	540	567	540	592	655	706	665	682	692	670	549	651	677	631			
Jacksonville, Fla.	18	5:15P	79	675	426	525	562	525	572	645	696	660	682	702	670	537	638	679	624			
Savannah, Ga.	18	10:00P	72	665	446	515	542	505	572	635	686	660	682	692	660	521	631	674	615			
Florence, S. C.	19	4:30A	57	655	466	515	552	505	562	625	666	650	662	682	650	524	618	661	607			
Reiced at Florence																						
Rocky Mount, N. C.	19	12:45P	64	625	386	475	512	475	522	595	641	620	642	692	610	487	586	641	578			
Richmond, Va.	19	4:45P	60	615	396	465	482	465	522	585	631	610	632	652	610	471	579	626	565			
Potomac Yards, Va.	19	10:15P	61	615	396	465	502	465	512	585	616	600	622	642	610	477	571	619	562			
Reiced at Potomac Yards																						
Harsimus Cove, N. J.	21	10:00A	--	555	---	435	467	440	457	505	551	545	562	567	545	447	504	555	507			

Average temperature of fruit entering the car during the loading period was 720°.



Figure 1

CAR A ORANGES (May, 1951) 535 BOXES
PRECOOLED IN ROOM PREICED
ITEM 80, SECTION 2, FANS ON
REICED AT FLORENCE

CAR B ORANGES (May, 1951) 535 BOXES
PRECOOLED IN ROOM PREICED
ITEM 80, SECTION 2
REICED AT FLORENCE

FRUIT TEMPERATURES
Avg. Top * * * * *
Avg. Mid - - - - -
Avg. Bot - - - - -

°F

A

B

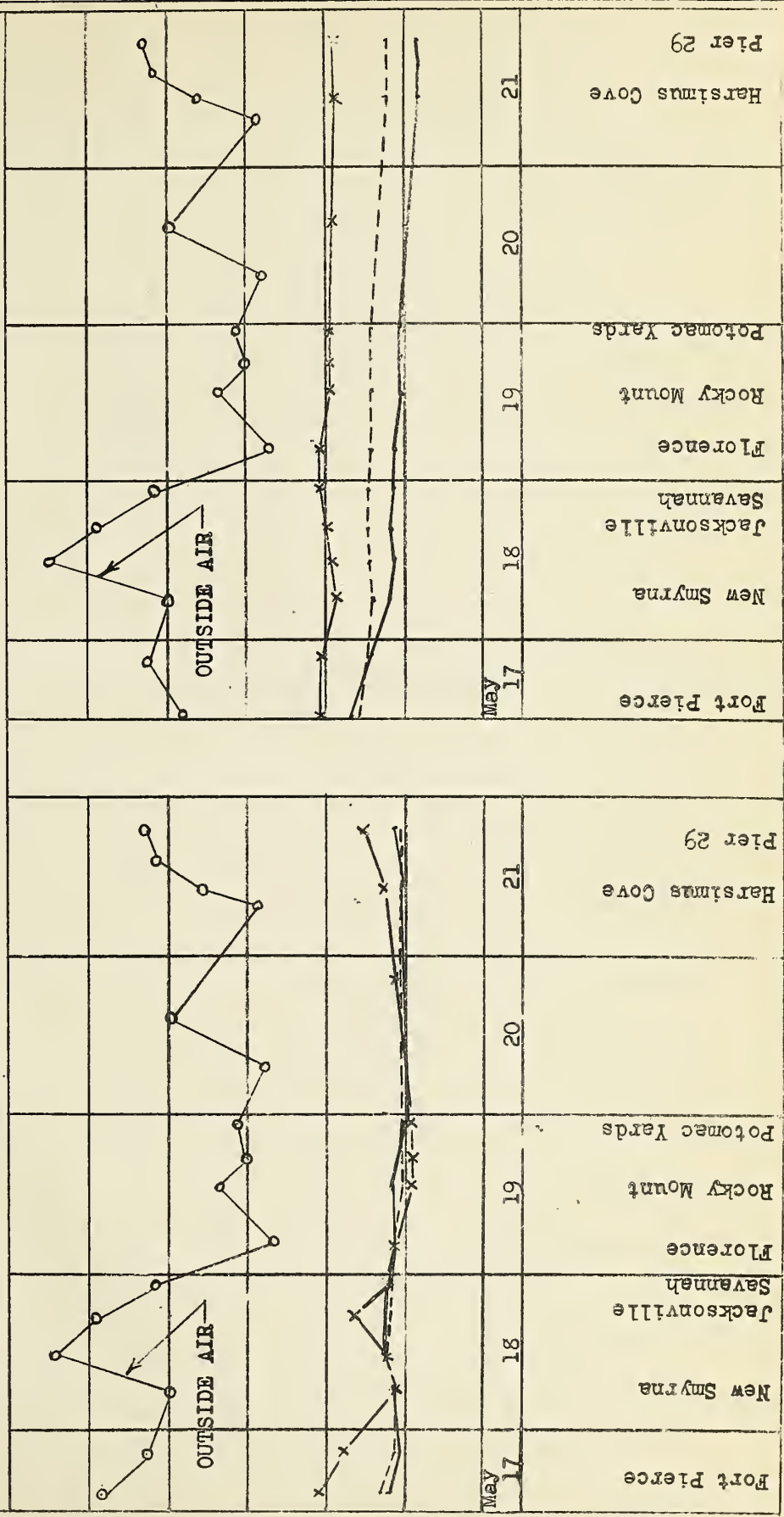




Figure 2

CAR D GRAPEFRUIT (May 1951) 512 BOXES
PREICED, ITEM 80, SECTION 2, FANS ON
PRECOOLED IN CAR WITH PRECO FANS
REICED AT FLORENCE

FRUIT TEMPERATURES
Avg. Top * * * * *
Avg. Mid - - - - -
Avg. Bot - - - - -

CAR C GRAPEFRUIT (May 1951) 517 BOXES
PRECOOLED IN ROOM, PREICED, STAGE ICED
ITEM 80, SECTION 2
NON-FAN CAR
REICED AT FLORENCE

°F

A

B

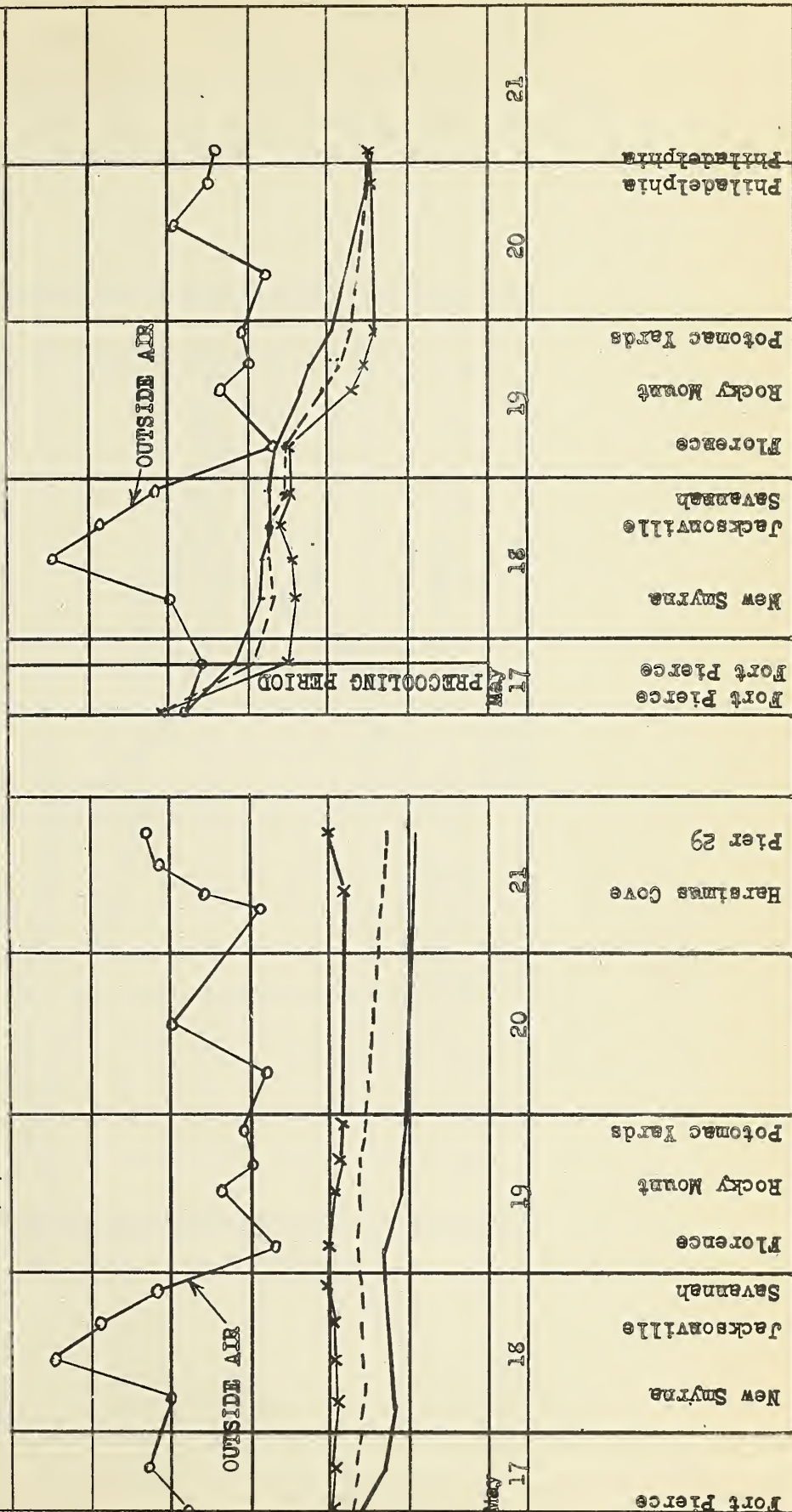




Figure 3

Commodity and Air
Temperatures in Precooling
Test with Preco Fans
Bunkers Preiced

CAR D
GRAPEFRUIT
IN 512 BOXES
BILLED WEIGHT 46592

FRUIT TEMPERATURES

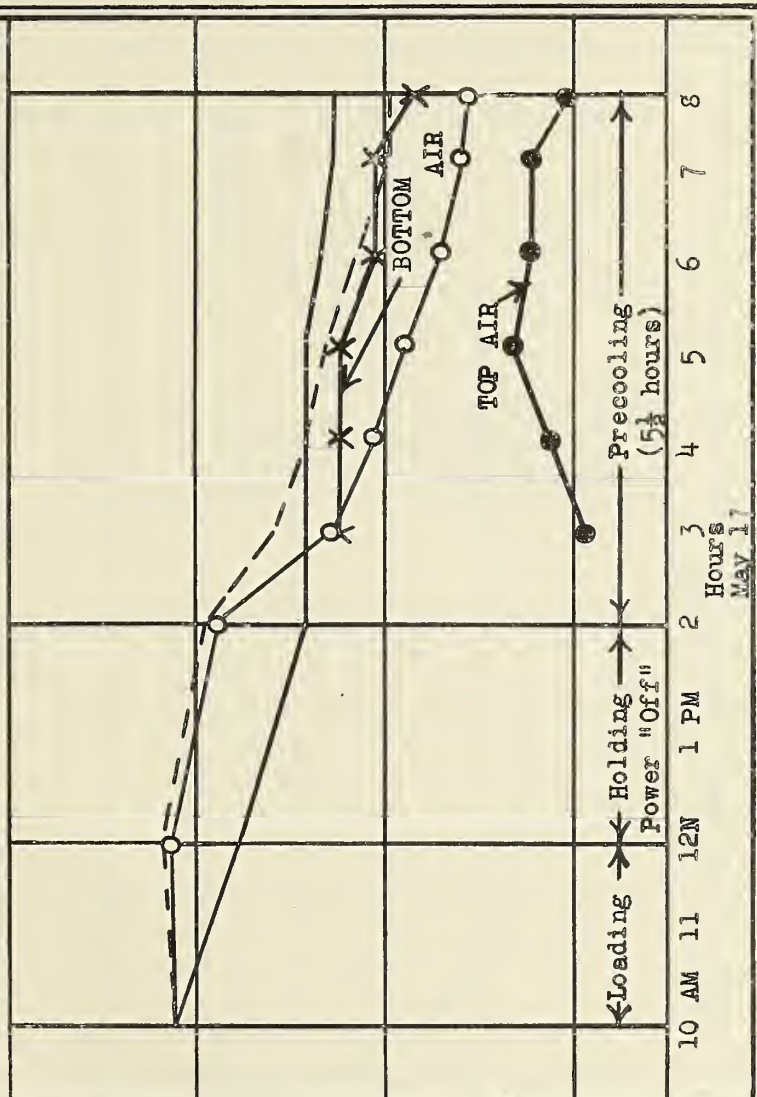
Avg. Top O—O
Avg. Mid - - - -
Avg. Bot ———

°F
80

70

60

50



10 AM 11 12N 1 PM 2 3 4 5 6 7 8

Hours
May 17



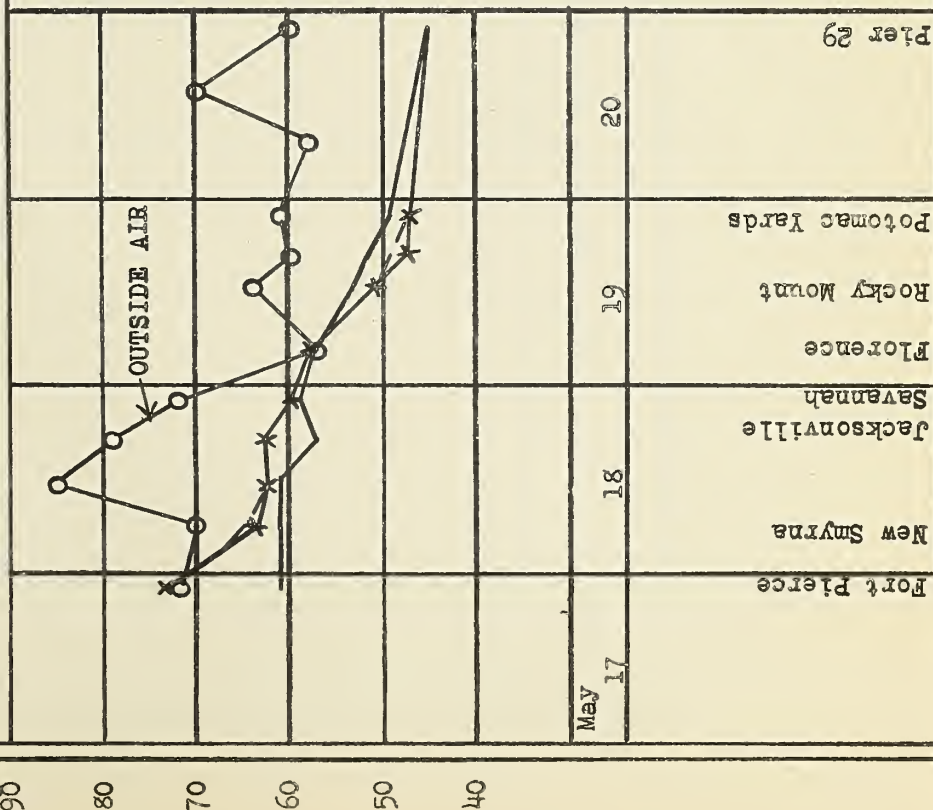
Figure 4

CAR E GRAPEFRUIT (May 1951) 487 BOXES
PREICED ITEM 80, SECTION 2, FANS ON
REICED AT FLORENCE

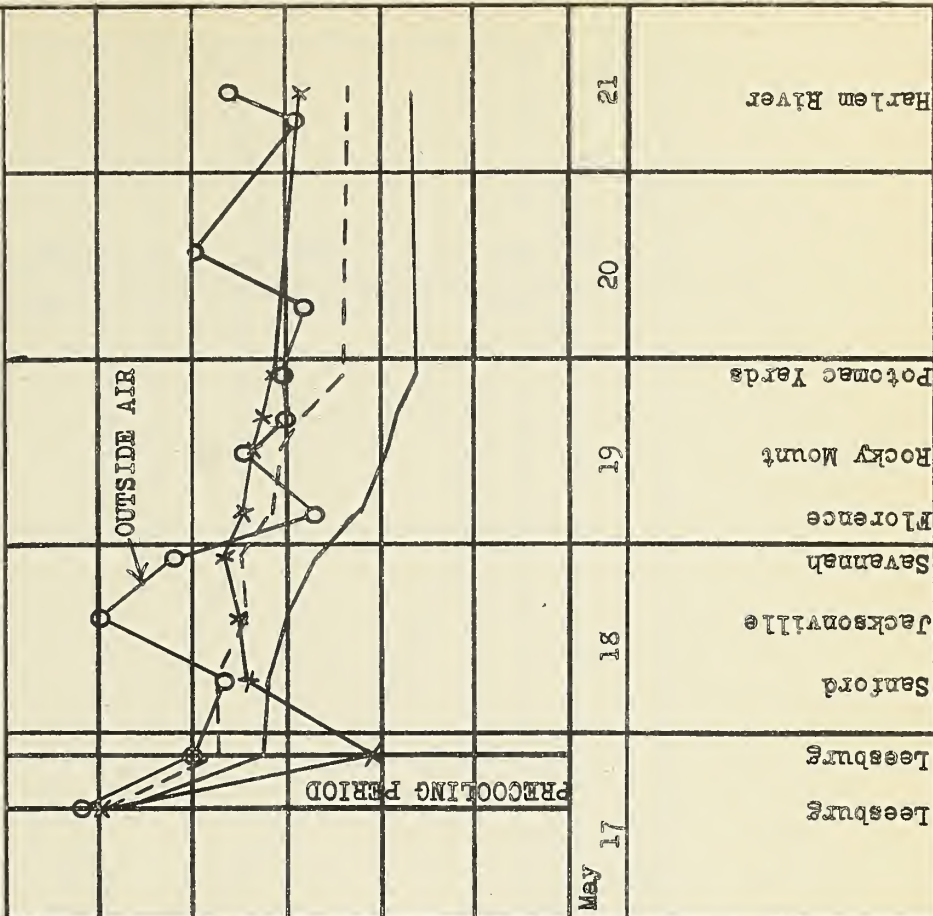
FRUIT TEMPERATURES

Avg. Top *
Avg. Mid - - -
Avg. Bot - - -

A



B



CAR F ORANGES (May 1951)
8576 5-LB. OPEN-MESH BAGS
PRECOOLED IN CAR, TRUCK-MOUNTED
UNIT INITIALLY ICED AFTER LOADING
ITEM 80, SECTION 2
REICED AT FLORENCE
DOUBLE-DECK NON-FAN CAR

FRUIT TEMPERATURES
 Avg. Top —○—
 Avg. Mid — — —
 Avg. Bot — — —

Figure 5

Commodity Temperatures
 In Precooling Test
 With Truck-Mounted Unit
 Bunkers Dry, Initially Iced
 11½ Hours After Precooling

CAR F ORANGES IN OPEN MESH BAGS
 BILLED WEIGHT 48,026
 DOUBLE DECK NON-FAN CAR

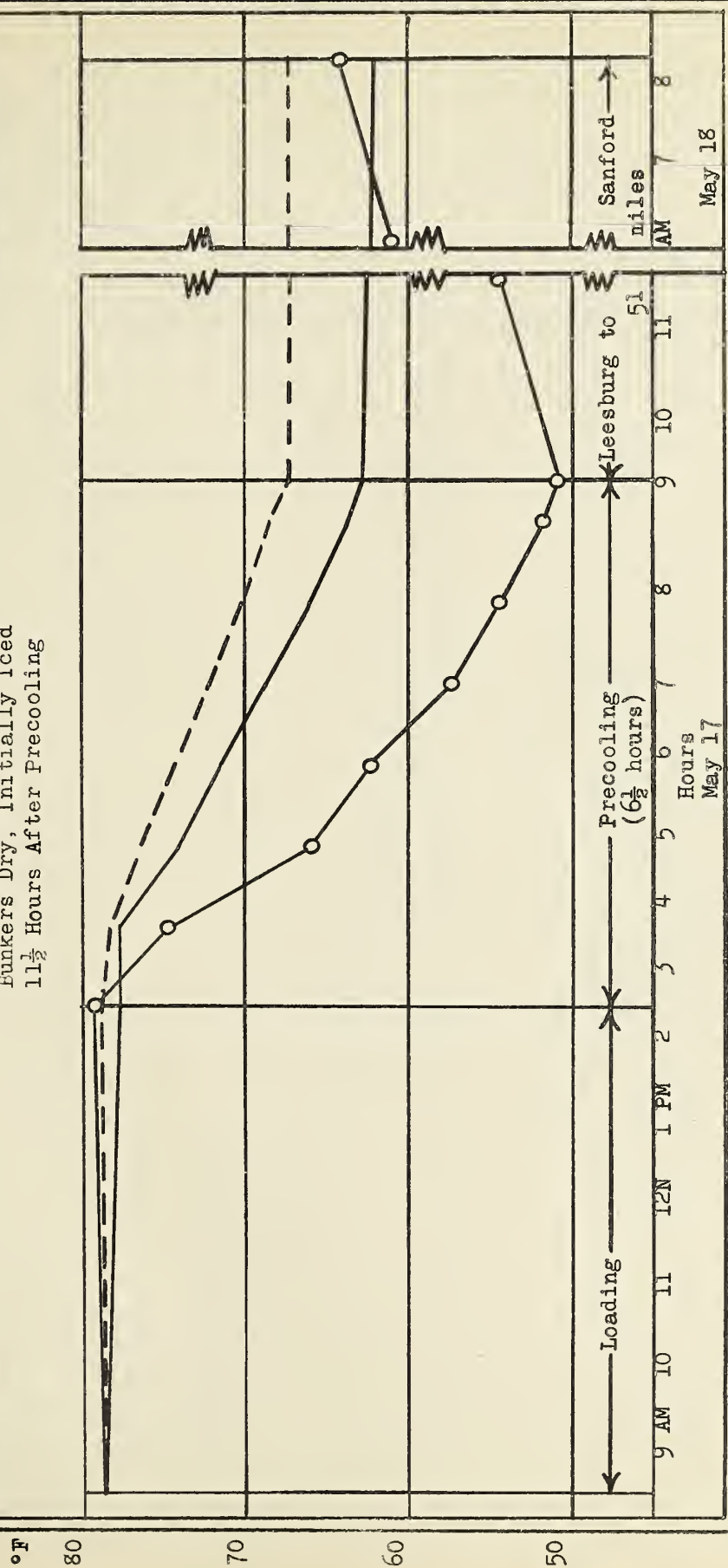




Figure 6

FRUIT TEMPERATURES

Avg. Top O—O—O
Avg. Mid — — — —
Avg. Bot — — — —

Commodity and Air Temperatures
In Precooling Test with Preco Fans
Bunkers Preiced

CAR G ORANGES IN OPEN MESH BAGS
BILLED WEIGHT 48,026
DOUBLE DECK FAN CAR

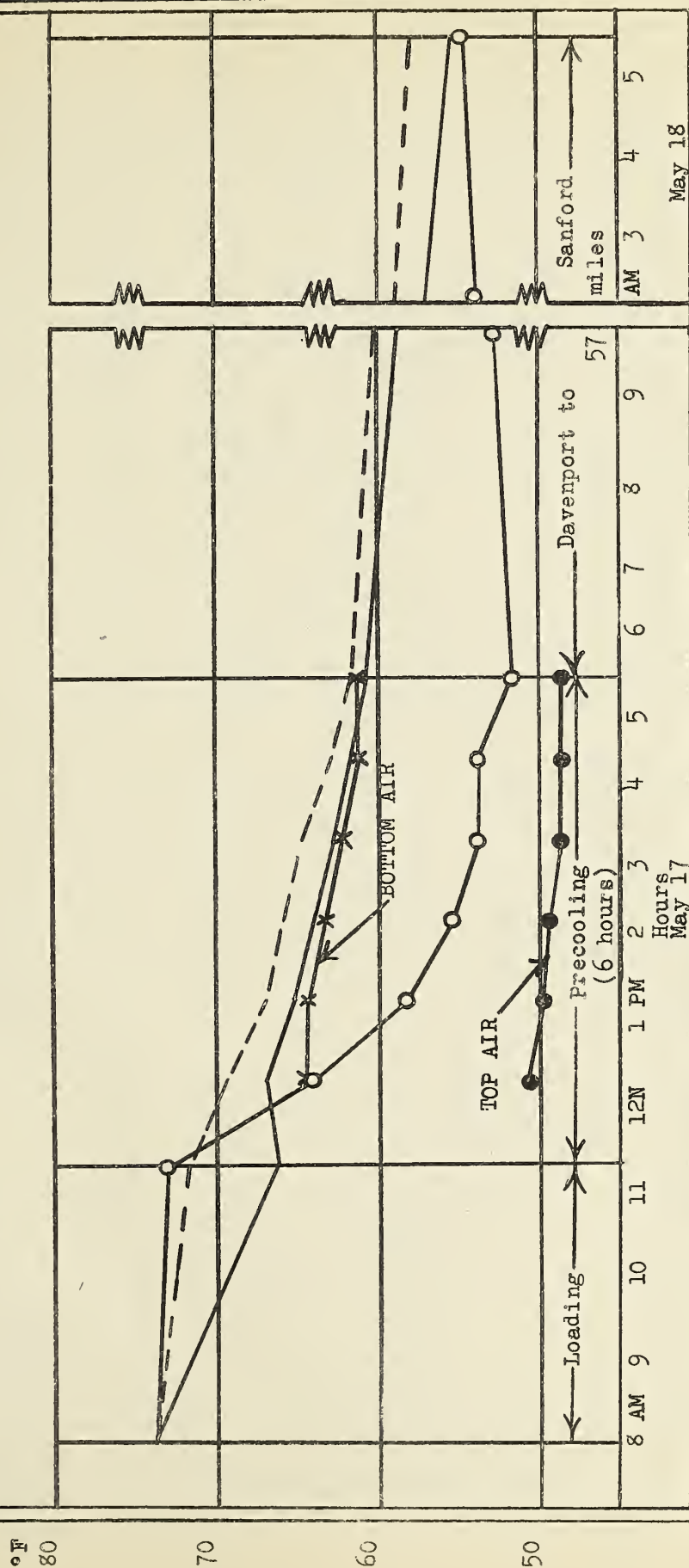




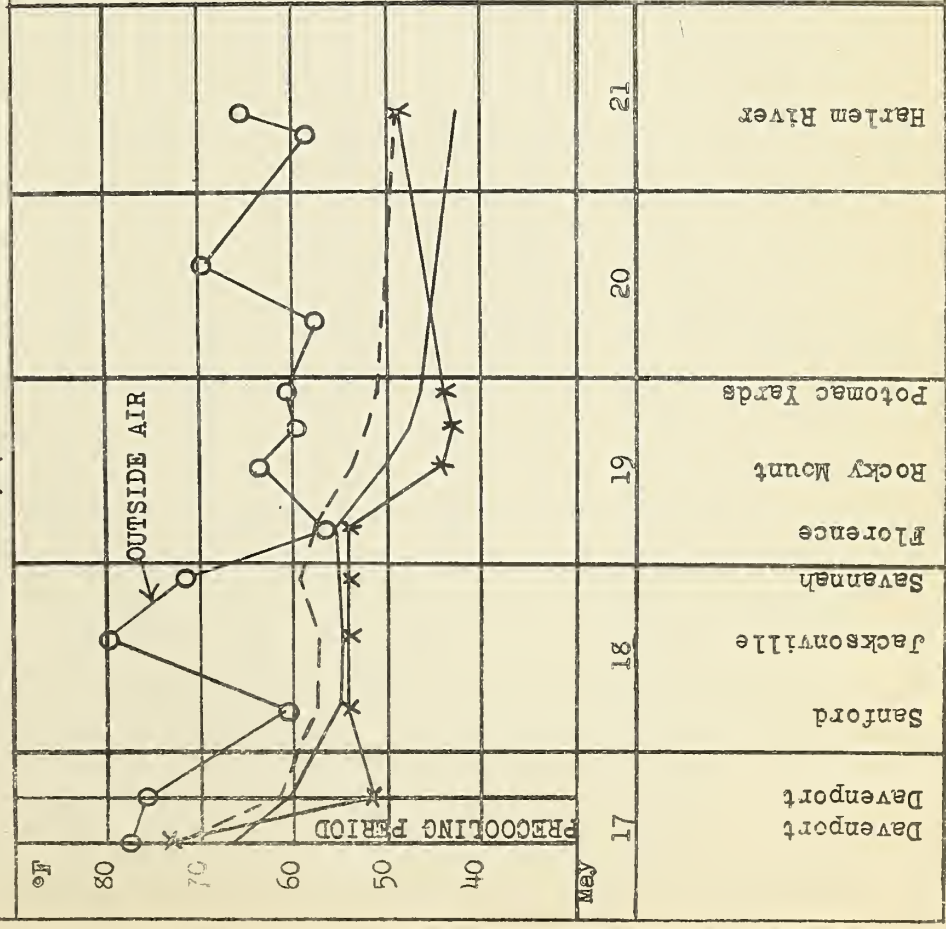
Figure 7

CAR G ORANGES (May 1951)
 8576 5-LB. OPEN-MESH BAGS
 PRECOOLED WITH PRECO FANS
 PREICED, ITEM 80, SECTION 2
 REICED AT FLORENCE
 DOUBLE-DECK CAR

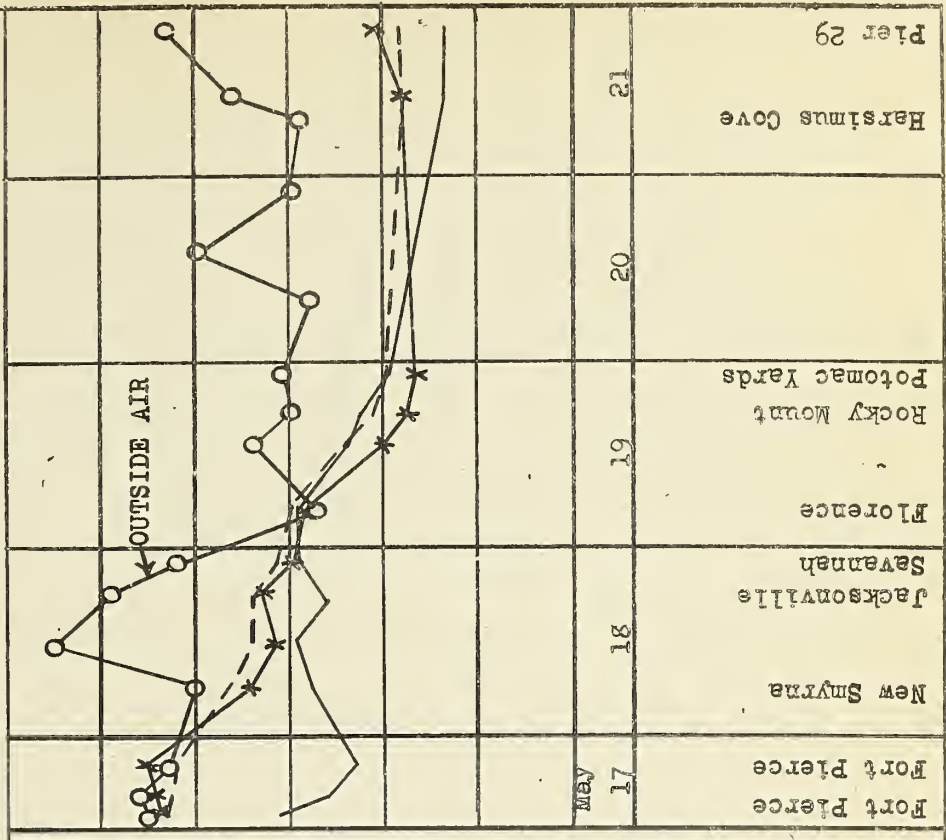
FRUIT TEMPERATURES

Avg. Top X — X —
 Avg. Mid - - - -
 Avg. Bot ———

A



B



CAR H ORANGES & GRAPEFRUIT (May 1951)
 517 BOXES PREICED ITEM 80, SECTION 2
 FANS ON, REICED AT FLORENCE

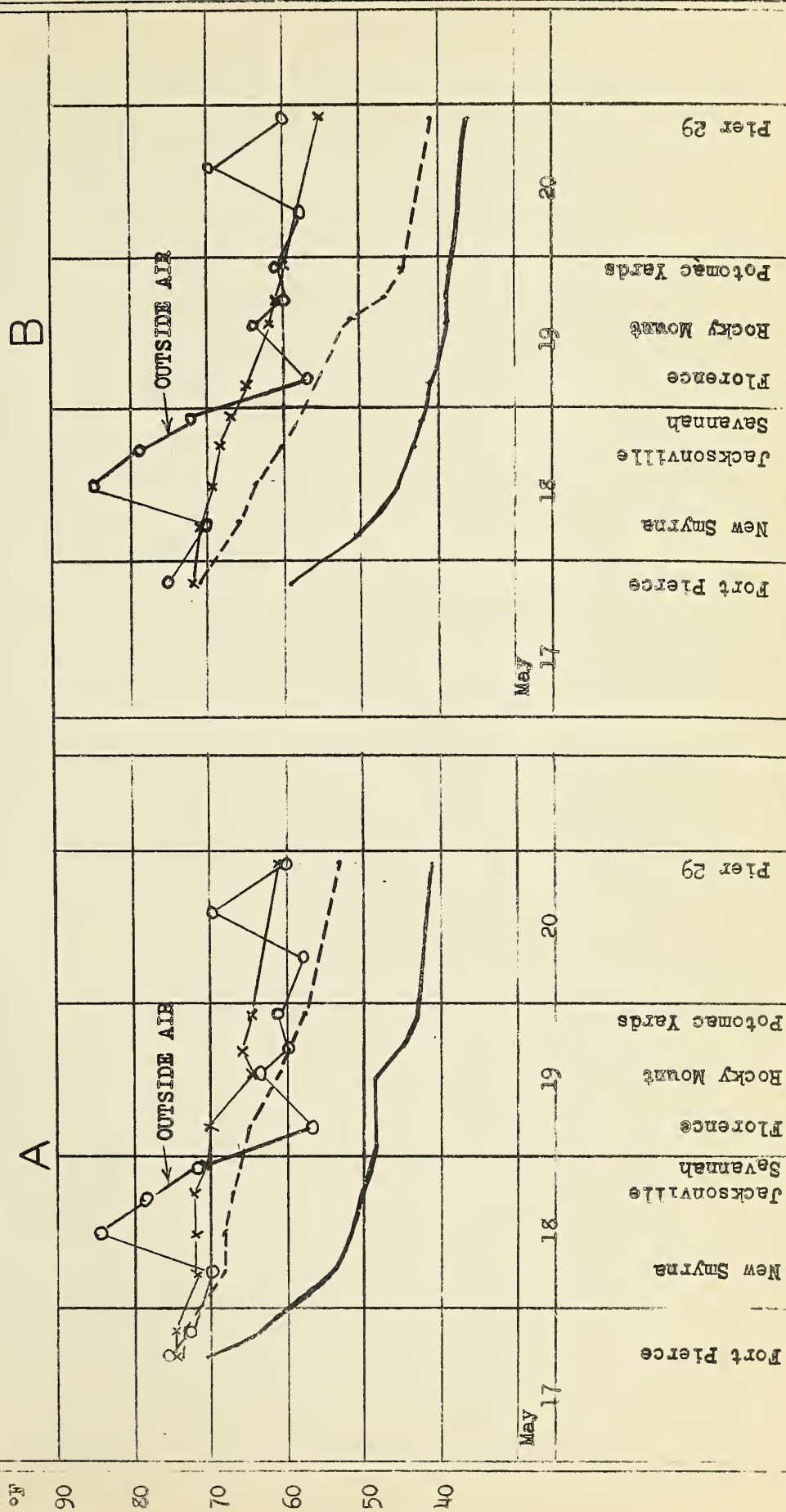


Figure 8

CAR I GRAPEFRUIT (May 1951) 500 BOXES
PREICED ITEM 80, SECTION 2
REICED AT FLORENCE

CAR J ORANGES (May 1951) 480 BOXES
PREICED STANDARD REFRIGERATION

FRUIT TEMPERATURES
Avg. Top * * * * *
Avg. Mid - - - - -
Avg. Bot _____





9

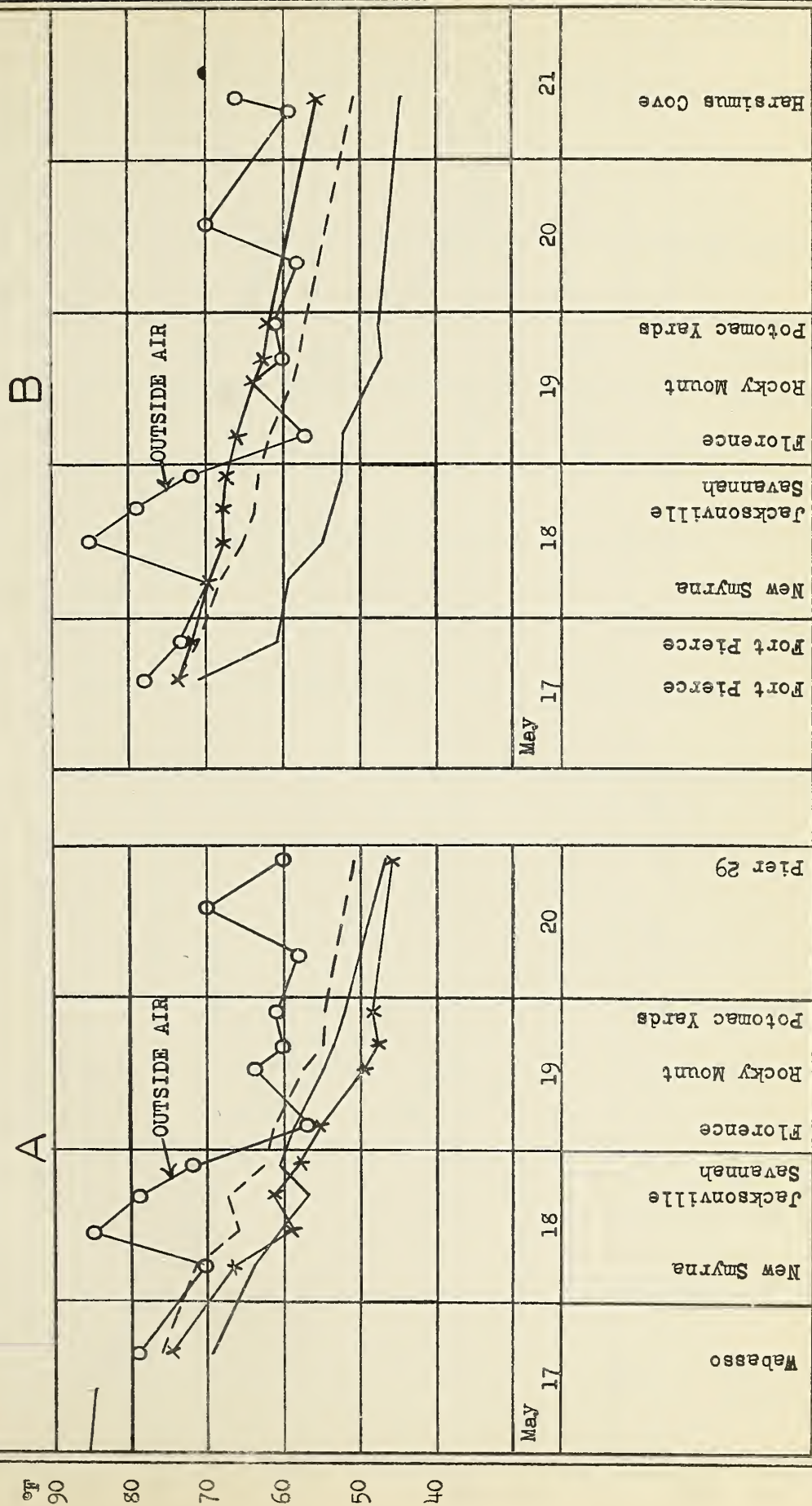
CAR L GRAPEFRUIT (May 1951) 512 BOXES
STAGE ICING STANDARD REFRIGERATION
PREICED

FRUIT TEMPERATURES

Top
Avg.

Aug. Mid. — — — — —

— Avg. Bot



COMPARISON OF ICING SERVICES

Std. Refrig. (Cars J, K, L)

Avg. Minimum

Avg. Maximum

Item 80, Sec. 2 (Cars E, H, I)

Avg. Minimum

Avg. Maximum

CONSOLIDATED FRUIT TEMPERATURES

COMPARISON OF ICING SERVICES

AND OF TYPES OF CARS

COMPARISON OF TYPES OF CARS

Non-Fan Service (Cars I, J, L)

Avg. Minimum

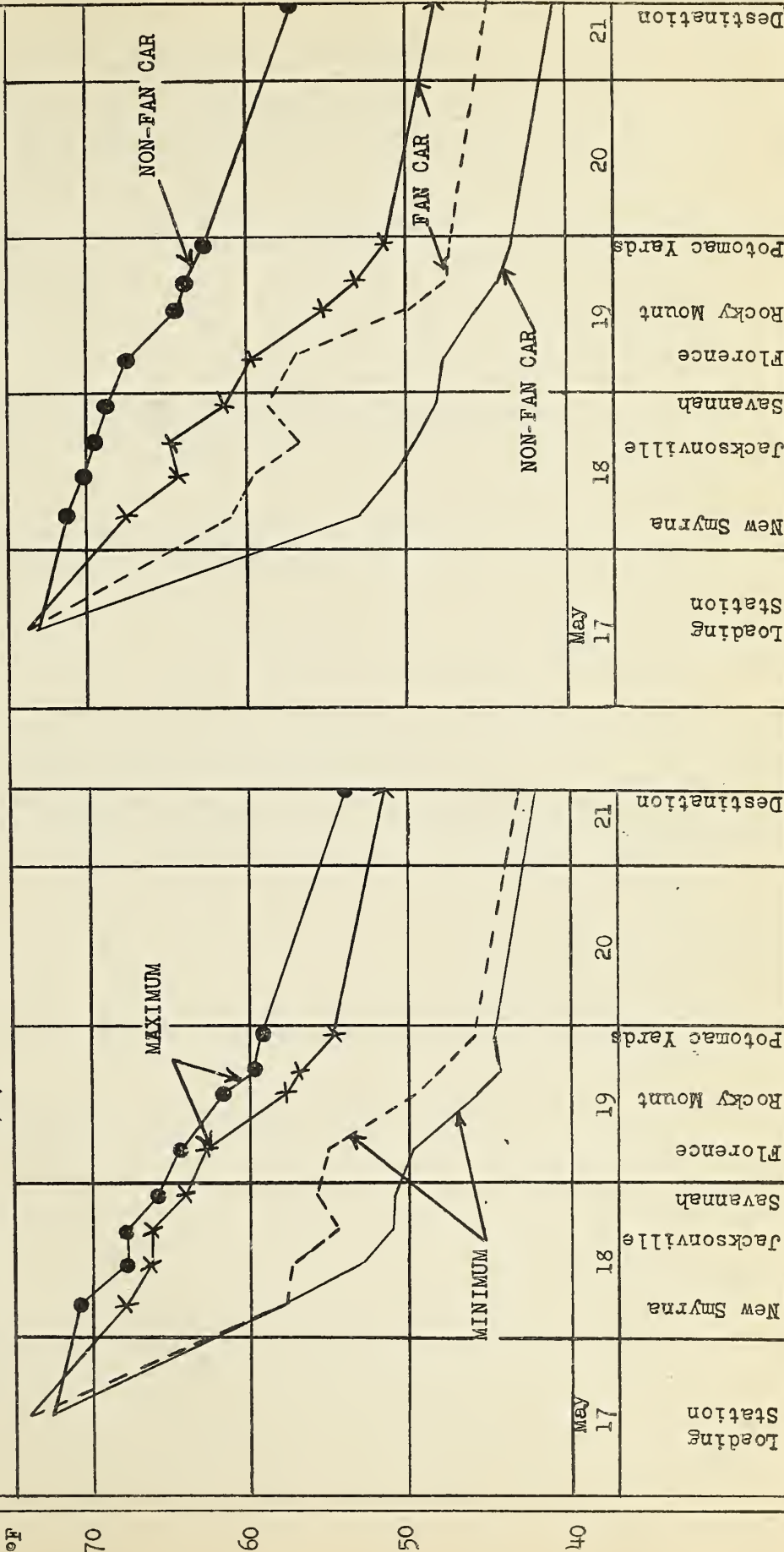
Avg. Maximum

Fan Service (Cars E, H, K)

Avg. Minimum

Avg. Maximum

A



B

